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The entrance to Miraflores locks, filled with the tidal water of the Pacific after dynamiting dike, as shown above.

BRINGING THE SEA TO MIRAFLORES LOCKS.—[See page 245.]

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

The Third American Road Congress

WE commend to the attention of everyone who is interested in the subject of transportation, the meeting of the Third American Road Congress, which takes place in Detroit from September 29th to October 4th, inclusive. Some one has said that transportation and civilization go hand in hand; and even a rapid survey of the pages of history will show that at least with regard to some of the broader phases of civilization, particularly those of a commercial and industrial character, there is a very intimate relation between the two. The masterful and farsighted Romans understood this fact so well that the road builder followed close upon the heels of the conquering army, and from the august city on the Tiber there radiated a network of roads, intelligently laid out and most excellently built, the greater part of which stands to-day as a monument to the wisdom and ability of that great people.

What was true in the days of the Roman Empire is trebly true to-day; and we need not go beyond the borders of the United States for proof that abundant and excellent means of transportation is one of the most potent agencies in the development, not merely of the physical but even of the moral and mental growth of a people. Would it be very far wrong to state that the most active agent in the enormous material development of the resources of the United States during the past half century has been the steam railroad? If courage, resourcefulness and hard work alone could have brought about the present conditions of amazing wealth and prosperity, the hardy pioneers who drove their way westward in the earlier years of the Republic, would have performed the task. But at the most they could do little more than merely locate the natural resources of the country, and await the day when some adequate and widely-spread system of transportation would be available to bring in the skilled and unskilled laborers and carry out the products of their toil.

The vast railroad system of the United States, comprising some 250,000 miles of track, stands to-day as a practically completed task—at least, so say the leading railroad operators, who are best qualified to judge. It now remains to supplement the work of the railroads by building a system of interconnecting highways, which will do for the tracts of country intervening between the various branches of our railroad system, what the system itself has done for the country at large. Had the suburban and farming districts never possessed any means of transportation to and from the railroads, or between the various towns and villages, other than the farm wagon and the buggy, the call for a system of well-built highways would have been imperative. The rapid development of the automobile and the motor truck, however, has given an enormous impetus to the agitation in favor of the construction of better highways, and we do not hesitate to rank the good roads movement as one of the most important before the American people to-day.

In justification of the foregoing statement, we quote certain facts recently recorded in this journal by the Director of the Office of Public Roads. In an article published in our issue of September 6th, Mr. Logan Waller Page drew attention to the following facts: That during the year 1912 automobiles in the United States paid in registration and license fees $5,638,878—a figure which exceeded the value of exports of automobiles from this country in the whole of 1906; that in 1911 we exported automobiles to the value of $16,924,361, exclusive of parts of the machines, and in the following year the total reached $23,703,989; that in the same year, we had nearly as many automobiles in New York State as there were in France and Germany combined; and, finally, that the total number of machines on our highways in 1912 was a round million.

Motor Truck Extension of Railroads

AN interesting suggestion for relieving the congestion at freight terminals may be found in the article by Mr. Robert L. Niles, published on another page. The subject is an exceedingly complicated one, on which much could be written, but the article referred to, while giving but a brief outline of the situation, offers the novel suggestion that freight terminal problems may be simplified by the use of motor trucks. In a small city the freight terminal is located near the business center and is of such capacity as to handle all the freight expeditiously and afford ample room for teamsters. But as the town grows the business radius is increased, lengthening the average haul of the trucks, while on the other hand more freight flows into the terminal, producing congestion, so that although more freight is handled, the profit in it is proportionately less. The larger the city the more valuable is the real estate around the terminal, making it costly to expand the terminal so that it can accommodate the freight with the same facility as it did in the beginning. To move the freight terminal to new and more commodious quarters, would in most cases be unprofitable to the railroad, because of the capital invested in the original location, and it would certainly be disadvantageous to the shipper or merchant because of the greater length of haul required.

However, if motor trucks are used instead of horse-drawn trucks the conditions are completely changed, for with its ability to cover the ground more rapidly, an extra haul of three or four miles is far less serious than a long delay at the congested freight terminal. Delays are advantageous to the horse because they allow him to recuperate, and store up energy for a greater effort. But the never-tiring motor truck should be kept on the move all the time, because only when it is in motion is it giving any value in return for the capital invested in it.

Hence, Mr. Niles argues that it might be advantageous to a railroad or a group of railroads to establish one or more annex terminals which will divert part of the freight that now clogs the main terminals and which would be readily accessible to motor trucks. The suggestion calls for a great deal of study, and although there are many difficulties that would have to be overcome, it is an exceedingly attractive proposition. It would mean the extension of the railroads to the final point of delivery.

Because delays in loading and unloading figure as a dead loss against a motor truck, efforts have been made to reduce this period to a minimum. Trucks are provided with mechanical loading devices, also with separate bodies which may be loaded or unloaded while the truck is in transit with another body. It might even prove practicable to transport the motor truck bodies fully loaded on flat cars. A flat car is nine feet wide, so that if the bodies were mounted transversely on the car, they could be made at least nine feet long, which would be ample for the ordinary motor truck chassis. The truck bodies mounted on rollers could then be loaded by the shipper, hauled to the railroad, rolled upon the flat car by means of a winch, clamped in position, and then at the other end of the line, be taken off on the motor truck chassis in the same way and hauled off to the merchant's warehouse. The time of loading and unloading would thus be reduced to a minimum, and would prove advantageous not only to the consigner and the consignee, but to the railroad as well, for the cars would be released almost immediately on arriving at the freight station. Furthermore, if the goods were properly packed at the factory it might be possible under certain conditions to deliver direct to the consumer instead of the warehouse.

Another promising development is the motor truck trailer. In a paper by Mr. Morgan Cilley, printed not long since in the *Engineering Record*, it was proven conclusively that a motor truck shows its greatest efficiency when hauling trailers. In other words, a motor truck can pull much more than it can carry. His tests showed that a 3-ton motor truck could maintain a sustained draft of more than 3,000 pounds, and that two trailers each loaded with five tons would require a draft of from 750 to 3,000 pounds. His tables show that the cost per truck mile with a motor and six trailers varied from 0.258 cent per half-mile haul to 0.103 cent per ten-mile haul, while the cost for a motor truck alone varied from 0.480 cent to 0.176 cent. By this it is not meant that the motor truck hauls a train of six trailers at a time, but only two, while there are two loading and two unloading. Trailers are now being made for this purpose, the wheels of which will track with those of the motor truck, so that there is no difficulty in turning corners or threading a way between obstructions. If such a method of handling freight should prove practical, motor trucks would probably be materially changed in design, because they would not have to support any load except their own weight. Thus we would have railroad freight trains quickly converted into trailer trains hauled by motor trucks or motor tractors in place of locomotives.

Questioned and Unquestioned Factors in Evolution

WHEN, some fifty-odd years ago, the theory of organic evolution was first widely published, it met with violent opposition in certain lay circles, opposition of which threadworn remnants still remain smoldering here and there. Strange how preconceived and biased judgment will induce men to deny what on closer examination is found to be an absolutely irrefutable proposition, in fact a truism, an axiom. For such is the principle of the survival of the fittest: It is absolutely uncontrovertible, because it is of the nature of a definition: The fit survives, it could not be otherwise, because we define the fit as that which survives. A mere definition can not be made the subject for argument.

So far then, the fundamental principle of the theory of evolution is unassailable. But when we proceed to a more detailed analysis of the theory ushered in by Darwin, Wallace, Spencer and others, we encounter a number of problems that are far from being settled beyond dispute at the present day.

In the first place, it might be said, if the principle of the survival of the fittest is a mere definition, then what gain is it to science and mankind? The mere setting up of such a definition adds nothing to our previously existing knowledge, it would seem.

Such an objection seems at first sight reasonable. No one, however, who is familiar with the laws of scientific thought would be found to endorse it. For it is well understood among those whose life is spent in solving scientific problems, that the first step toward success, and often a step more difficult than appears on the surface, is the clear *formulation* of the problem. Indeed, once the problem is thoroughly understood, its solution is often not far to seek. The great value of the principle of the survival of the fittest, is that it has served as a most valuable guide in directing scientific inquiry.

True, the fit is merely defined as that which survives, but this at once raises the question: What are the characteristics of a given type by virtue of which it is fit? And thus we find ourselves led on to a study of the laws of mortality, fecundity, selective mating, heredity, and so forth. Nor is this justification of the principle merely hypothetical: the vast amount of work which has followed in the train of Darwin's epoch-making publications, and the intensely practical results which have flowed to the plant and animal breeder (to mention only one example), speak more convincingly than the most astute philosophical argument.

In brief, as to the operation of natural selection, and its significance in organic evolution, there can be little doubt. But when we approach the question of the material presented to nature for selection, we find ourselves surrounded on all sides by debatable ground. Does nature select from offspring which differs from its parents by small and gradual variations? If so, has life upon earth existed for a period sufficiently long to account for the great changes in biological species which are known to have taken place? Or is the selection made from among so-called sports or mutants, offspring which for some ill-understood reason differs markedly and by a sudden leap from its parent? Or yet again, is such selection of well-adapted types assisted by the inheritance of useful characters acquired by the parent within its life time? Probably each of these factors plays a part in the development of species, but to what extent is an unsettled question.

Incidentally it is interesting to note that in the case of man, and especially modern man, a new factor enters—the material offered for selection is created by a new process. Variation, mutation, heredity, all these refer to physiological processes of production. Thus the ear seems to have been evolved from a structure corresponding to the gill cleft of a fish. But that artificial ear of modern man, by the aid of which he can hear and understand conversation over a thousand miles, is not a physiological product of flesh and blood, but a thing made with human hands. Here we are no longer bound by the fetters of slowly accumulated variations, nor at the mercy of capricious mutations. Man is free to give his genius free play, and as the result the past century has seen such a flood tide in evolution as must be wholly unprecedented in the millions of years of our earth's past history.

Electricity

Electric Fan in a Perfume Shop.—With the object of luring customers into his shop, a perfumery merchant of New Orleans, La., has placed an electric fan in his doorway to carry out into the street the enticing odors of his shop. An attendant with an atomizer sprays the fan with various perfumes.

Telephone from Holland to England.—A submarine telephone is to be laid between Holland and England. The length of the cable will be no less than 105 miles. According to the present project, the total expense will be near $3,000,000 and will be borne conjointly by the two countries. On the Holland side, the starting point of the cable will no doubt be at the locality of Westkapelle in the island of Walcheren.

Speed of Hertzian Waves.—Experiments with Hertzian waves between Toulon and Paris by Messrs. Abraham Dufour and Ferrié show that the waves travel with a speed of 295,990 kilometers per second. The speed of light waves is 300,000 kilometers per second. Experiments are now to be conducted to determine whether the speed of Hertzian waves across the sea is the same as that over land.

Wireless Train Dispatching.—After a careful investigation the Superintendent of Telegraphs of the Atchison, Topeka and Santa Fé Railway has come to the conclusion that it is not advisable to install wireless telegraph apparatus along the railroad, not only because of the expense of installing and maintaining the stations, but also for the reason that wireless telegraph communication can too easily be interfered with to make it sufficiently reliable for railroad use.

The Largest Electric Mine Hoist, says the *Electrician* (London), is being installed in a South African mine. A shaft is being equipped with a 4,000 horse-power hoist to be operated on the mains of the Victoria Falls Power Company, without any attempt at equalization of the maximum and minimum power demand, which means that the motors will require something like 7,000 horse-power during acceleration, resulting in a load of 9,000 horse-power on the transmission line. The equipment will consist of two 2,000-horse-power continuous-current motors, one at each end of the drum shaft of the hoist. The motors will receive current at 5,000 volts from a motor generator converting the 50-cycle 3-phase current to continuous current. The motor generator will comprise a 5,000-horse-power 3-phase induction motor, operating on a 2,000-volt circuit, directly coupled to two separately excited continuous-current generators, each of 1,650 kilowatts capacity.

Magnetic Separators.—In different kinds of grinding mills it is found that fragments of iron cause disastrous explosions, as for instance in an English oil works where iron turnings in the mills gave sparks which set fire to the inflammable material. A number of works in Europe, and especially the ones which suffered from this class of accident, are making use of magnetic separators in the shape of revolving drums. Inside the drums are powerful electromagnets which cause the iron particles to adhere to the surface of the drum, so that the pieces are taken up and delivered over to the other side where a suitable scraper takes them off. In the improved types, the inside magnets have a winding of aluminium wire, self-insulated by oxide, so that the coils are heat and moisture proof and the device is very reliable. Such magnetic separators are recommended for cocoa or bone mills, chemical works, coal crushers, sugar refineries and grain mills, as well as in the textile industries. We may mention one case where iron particles caused a fire in a Wurtemburg spinning factory, where $20,000 worth of cotton was burned. This class of works, together with oil mills, appear to be the most in danger from the presence of iron particles.

A Historic Gavel.—At the opening session of the Illuminating Engineering Society in Pittsburgh, on Sept. 22d, Prof. George A. Hoadley of Swarthmore College presented to the Society on behalf of the Philadelphia section a gavel that forms a miniature exhibit of the development of artificial illumination in America. The candle is represented by a tin handle from a candle making apparatus; the oil lamp by two pieces of iron obtained from a bracket, the design and making of which were supervised by Benjamin Franklin; the gas mantle by a vial containing the original Welsbach lighting fluid, made in the Welsbach laboratories in 1888; the arc lamp by an electrode used in the first magnetite arc lamp in 1903; arc lighting by a piece of single conductor cable installed by the municipality in Philadelphia for arc lighting about 1890; the incandescent lamp by a die that Thomas A. Edison used in his early experiments in making paper filaments in 1879; the vacuum tube lamp by a piece of electrode of one of the Moore-light vacuum tubes, exhibited at the first New York electrical show in 1896; lighting service by a piece of the first Edison 3-wire cable installed in Philadelphia; while the gas industry is represented by a piece of gasholder of 85,000 cubic feet capacity, designed in England and built in Baltimore by the first gas company in America.

Science

The Seventh Centenary of Roger Bacon's Birth will probably be celebrated in England next year by the erection of a statue in honor of this early champion of experimental science, in the Natural History Museum at Oxford, and by raising a fund for the publication of his works.

The Buys-Ballot Medal of the Royal Academy of Sciences of Amsterdam, which is awarded every ten years for distinguished work in meteorology, has just been granted to Prof. H. Hergesell for his investigations of the upper atmosphere in subtropical and circumpolar regions.

A University for Central China.—The suggestion to establish a university on occidental lines in central China is arousing much interest in Great Britain, where efforts are being made to induce the government to aid the enterprise by remitting the sum of £250,000 from the Boxer indemnity. The amount of the latter claimed by Great Britain was £7,000,000, but only £199,000 of this has been paid.

Solar Observatory in New Zealand.—The long-felt need of solar observatories in the southern hemisphere has been met in recent years by the establishment of such institutions in India and Australia, and now it is announced that one will be established shortly in New Zealand. The funds for building, equipping and endowing the new observatory have been offered by Mr. Thomas Cawthron, of Nelson, N. Z. Sir Robert Ball has been requested to send a representative to New Zealand to select a suitable site and furnish advice as to equipment.

The Metcalf Comet Observed by Brooks.—The new comet recently discovered by Mr. Joel Metcalf has been observed by Dr. William R. Brooks at the Smith Observatory, Geneva, New York. It is in the northern sky just above the head of the Lynx, and its motion is northerly. The comet is telescopic, rather faint at discovery, but has grown somewhat brighter. It is a round nebulosity, without a tail. Perihelion passage, or nearest approach to the Sun, occurred on September 14th, in position right ascension 6 hours 10 minutes; declination north 67 degrees 12 minutes.

The Samoa Observatory at Apia, originally established in 1902 as a temporary place of meteorological and geophysical observations in connection with the international antarctic expeditions, has gradually assumed a permanent status and become the most important scientific institution in the South Seas. It is conducted under the auspices of the Royal Society of Science at Göttingen, and supported by the German government, which has just authorized a substantial increase in the revenues of the institution. At frequent intervals a new director is sent out from Germany to relieve the old one. Dr. Ludwig Geiger, who has just taken charge in succession to Prof. Angenheister, proposes to make a special study of atmospheric electricity during the rainy season, and has taken with him a fine equipment of instruments for this purpose.

An Exhaustive Study of the Cactus Family, with respect to taxonomic, geographic and economic features, has been undertaken by the Department of Botanical Research of the Carnegie Institution, Dr. N. L. Britton, director of the New York Botanical Garden, and Dr. J. N. Rose, of the Smithsonian Institution, being in charge of the work. Dr. Rose has been studying the great collections of Cactaceæ in Europe. The field work will begin with an exploration of the West Indies and the north coast of South America, followed by work in the deserts of Argentina. A large number of volunteer collectors and botanists in the southwestern United States, and about twenty Government explorers, are sending in material. Two or three years will be spent in assembling and organizing the collections. A series of volumes dealing with these highly specialized plants will be published.

Work of the "Anton Dohrn."—Dr. Alfred G. Mayer, director of the Department of Marine Biology of the Carnegie Institution, calls attention to the broadening of the work of his department made possible by the acquisition of a staunch 70-ft. twin-screw yacht, the "Anton Dohrn." The whole West Indian-Florida region has been opened to the activities of Dr. Mayer and his staff, and it is proposed to commence a series of biological oceanographic researches embracing the interesting region of the Caribbean Sea and the sources of the Gulf Stream. Already a cruise of 570 miles has been made among the Bahamas. Thus we have in America a parallel to the remarkable activities of the "Michel Sars" in European waters. Dr. Mayer says: "It should be a source of regret to us in America that our country, which during the mid-decade of the nineteenth century under Maury and Bache led all others in the scientific study of the sea, should now have fallen into an insignificant place in such researches. Our country, which fostered the labors of Louis and Alexander Agassiz, and of Pourtalès, Sigsbee and Tanner, should not now be content to lapse into desuetude (*sic*) respecting this important field of study."

Aeronautics

The 1913 Gordon Bennett Balloon Race.—The spherical balloon commission of the Aero Club is occupied with organizing the Gordon Bennett Cup event, which is to take place in October. The following prizes will be awarded: First prize, known as City of Paris prize, $2,000. Second prize, $1,000. Third, $500. Fourth, $300. Fifth, $200. Also objects of art. As usual, the start will take place from Paris.

Competition for Highest 1913 Total Mileage.—Several of the French aeroplane pilots are competing for the cup which is to be awarded for the longest total distance covered before December 31st. Fourny is at the head of the list at present and has been making flights every day in the region of Paris for the last two weeks, having at last accounts footed up 9310 kilometers (about 5770 miles).

The Michelin Bomb Dropping Contes .—The second part of the aerial target contest for the Michelin prize of $10,000 held during September shows some interesting conditions. The rules call for the placing of 15 shot or imitation bombs of 6 inch diameter and 15 pounds weight, with aeroplanes plying at 200 meters (656 feet). The target traced on the ground is a circle of 66 feet diameter. Different aerodromes have entered pilots for the tests, there being the Farman at Buc, with 9 pilots, the Étampes aerodrome with one Farman aeroplane, and the Chalons and Vidamée, each with one pilot. Six of the competitors are army officers.

The Bonnet Prize for an Automatic Stabilizer Performance.—In view of the progress which is being made in the way of automatic stabilizing for aeroplanes, the National Aerial League of Paris is promoting the question. Engagements are now open at the League for the lately-founded Henri Bonnet prize, to be awarded to the first pilot flying in a wind of at least 15 feet per second, is able to cover a distance of at least 12 miles without touching the levers for the vertical steering rudder or for the ailerons. The horizontal steering rudder is to be independent and can be used on this occasion, as the object is to have an automatic stabilizing in the vertical sense.

Monoplanes and Biplanes Compared.—For aeroplanes of equal span, cross-section, aspect-ratio and angle of inclination, the monoplane has about 15 per cent more lift than the biplane for equal speeds, according to F. Handley Page, the English designer. A monoplane has a smaller resistance than the corresponding biplane, but the difference is not great. What is gained in the monoplane by having no plane struts is lost, however, by the increased size of the under-carriage members for a given size of propeller. For machines having an area of 250 to 275 square feet, the monoplane is conceded to be the more economical type, but beyond this point the biplane is superior.

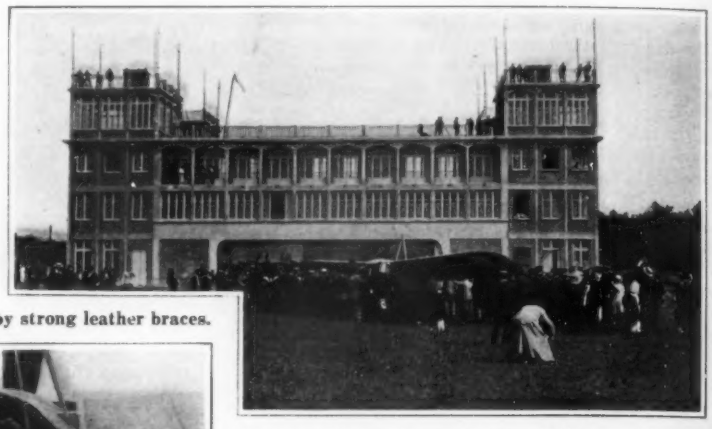
The French Gordon Bennett Competition.—The following are the competitors which were drawn by lot at the Paris Aero Club for the Gordon Bennett Cup eliminatory trials for aeroplanes: Deperdussin monoplanes will be mounted by Prevost, Gilbert and Rost; Barel monoplanes by Daucourt and Chemet; one Bréguet biplane by Brégi; a Nieuport monoplane by Espanet and a Ponmier monoplane by Védrines. The trials take place September 26th, and the rules call for a run of 60 miles. Competitors are allowed to make three trials and to choose the time of starting. The first three aeroplanes classed in this event will defend the French colors in the Gordon Bennett race, which is fixed for September 29th, while the next three pilots will form a reserve.

War Experience in Air Scouting.—Both in the Tripolitan and Balkan campaigns the aeroplane was used with good effect. In Morocco air scouting frustrated ambushes, forestalled unexpected attacks by superior numbers, and alleviated the mental tension of the commanders, because they were always enabled to know the strength of their Arabic and Turkish enemies. All this was merely of a defensive nature, for the character of the country and the climate made it impossible to decide the war by vast offensive operations in which the air scout might have been all-important. The aeroplane might have played an important part in the Balkans had the aviation corps of the allies or of the Turks been prepared. Unfortunately, they were not organized to move with the field forces. Like siege artillery, they reached the front last. What they really accomplished is still the secret of the observer-officers and of the general staffs. The pilots of the machines were not taken into the confidence of their passenger observers. Indeed, they often complained that they were acting blindly, and that they could not perform their functions efficiently as a consequence. In a sense the air service in the Balkans was at times of a defensive nature. It frustrated sallies from besieged fortifications because the air scouts saw what was coming and could notify their commanders to prepare themselves. Although not decisive factors in the war, the machines became indispensable. Any news about the enemy appears highly important to a commander after he has become accustomed to the great convenience of having flying machines.

Turning Somersaults With an Aeroplane

The Remarkable Exploit of Adolphe Pègoud

Pégoud makes a speech to his admirers after his second somersaulting performance.



The spectators thronged around the machine in which Pégoud turned somersaults.

Pégoud was strapped down by strong leather braces.

IN last week's issue of the SCIENTIFIC AMERICAN, we described the remarkable feat performed by Adolphe Pégoud in jumping from a flying aeroplane with a parachute. Since that exploit was performed, Pégoud has accomplished the still more extraordinary feat of turning a somersault in the air in a Blériot monoplane. Pégoud performed his somersault twice, once at Buc on September 2nd, and again at Juvissy on the following day. When the news was first cabled to this country, experienced aviators and designers shook their heads in doubt. Orville Wright, for example, was quoted as one of the skeptics. He pointed out, with others, that the gravity fuel feed of the aeroplane would be cut off as soon as it was turned upside down, so that even a short journey in an inverted position seemed improbable.

For all that the feat was unquestionably performed, as the accompanying photograph showing the machine upside down abundantly testifies. That it was accomplished at all is due to the fact that it formed part of a *vol piqué*. Mr. Wright was absolutely correct in stating that flight in an inverted position could not be maintained on a straight line for any considerable length of time.

The Blériot monoplane used for these acrobatics was a single-seater of the XI type, built in 1912. The position and height of the upper *cabane* was slightly modified and the bracing of the fixed tail plane was reinforced. As one of our illustrations shows, Pégoud was strapped into his seat with leather braces passing over his shoulders. Rising to a height of 3,500 feet, Pégoud cut off his engine. Turning the nose of his machine down, he dropped almost in a vertical line. At a height of 1,600 feet he pulled his *cloche* and forced the machine on its back. Thus he glided for five hundred yards at a slight downward angle. Again Pégoud worked his *cloche*. The machine assumed a vertical position again for a few seconds, then straightened out in a glide, and came to earth in its normal position.

Pégoud states that while he was flying upside down, the gasoline leaked drop by drop out of his fuel-tank, and fell into his face. The draft from the propeller blew it all over him like a spray. "It was just like being in a barber's chair upside down," was Pégoud's reply to the question: "What did it feel like?"

It might be supposed that Pégoud is a hardened aviator. As a matter of fact he is only twenty-four years of age and took out his pilot's certificate on February 8th last.

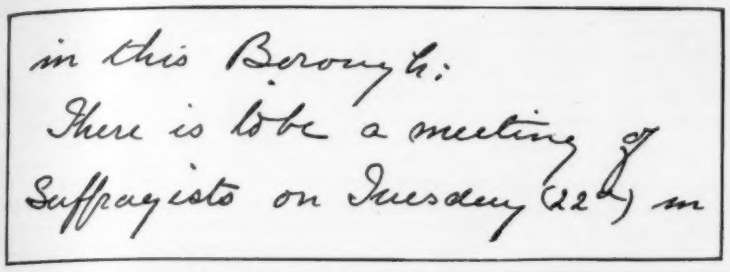
In our issue of May 31st, 1913, we recorded the somersault of Capt. Aubry of the French army while flying a Deperdussin. The captain was flying against a wind of about twenty-two miles an hour. At 2,500 feet, a series of violent gusts struck the machine. He was obliged to dive in order to control his machine. As he dipped, a few quick successive gusts struck the top of the main planes, and placed him in a vertical position. While endeavoring to manipulate the elevating rudder, he found the machine had taken him in a perfectly vertical drop to less than 1,500 feet. Here it assumed a horizontal position upside down and proceeded to effect a tail-first *vol piqué*. Somehow the pilot retained his seat. The machine then gradually assumed its vertical position again. Flattening out, the captain flew to a spot about two miles distant.

Pégoud's feat is more remarkable because it was deliberately performed, not only once, but twice. If Pégoud's performance has any value whatever, it shows that monoplanes can be so constructed as to withstand even abnormal strains. It also shows that a pilot with a cool head and perfect control of his machine can save himself even in a most perilous position if he is high enough from the ground.

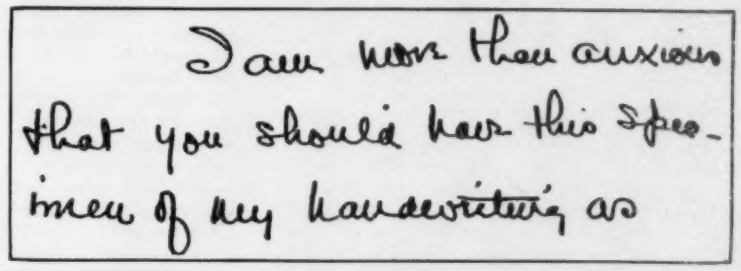
This unretouched photograph distinctly shows Pégoud flying upside down.

The Nature of Radio-telegraph Waves

IN a paper read before the British Association for the Advancement of Science, Prof. G. W. O. Howe, M.Sc., states that a very clear conception of the nature of the electro-magnetic waves employed in radio-telegraphy can be obtained by considering those electro-magnetic waves which exist in the space between the two conductors of a single-phase transmission line. If the conductors are flat, parallel strips, close together, and connected at the sending end to the terminals of an alternator, there is a certain value of the non-inductive load at the receiving end which will absorb the arriving energy without any reflection. Under these conditions the current and voltage are in phase all along the line, and the same is true if the line is assumed to be of infinite length. Line resistance and leakage are assumed to be negligible. It follows from this that the electric and magnetic fields at any point have their maximum values at the same moment. Instead of two parallel strips transmitting energy in one direction, two parallel disks of infinite extent can be imagined with the alternating P.D. applied between their centers. Energy would then be transmitted radially in all directions in the plane between the disks. The earth could take the place of the lower disk, while the upper one could be represented by a conducting horizontal plane some distance above the earth. The waves produced would be truly cylindrical, whereas those employed in radio-telegraphy are spherical. If, now, the upper disk is replaced by an inverted conducting cone of infinite extent, with its apex almost in contact with the earth, the alternating P.D. being applied between the apex and the earth, the electro-magnetic waves will be almost identical with those employed in radio-telegraphy and will vary in the same way with the distance from the sending station. This imaginary multi-directional transmission line, consisting of a lower plane (the earth) and an inverted cone, lends itself to simple calculation, because, like an ordinary transmission line, and unlike the two parallel disks, it has a constant inductance and capacity per mile. If the angle between the cone and the earth is 70 degrees, the relations between the magnetic and electric fields near the earth's surface and the total energy radiated are identical with those existing in the ordinary radio-telegraphic wave. As in the transmission line already considered, the current and P.D. will be in phase at every point, and therefore, the horizontal magnetic field and the vertical electric field due to a sending antenna are not 90 degrees out of phase but are approximately in phase, except immediately about the antenna. This also follows from the fundamental equations of a progressive, as distinct from a stationary, electro-magnetic wave.



No. 1.—A woman with diplomacy, tact, and administrative talent.



No. 2.—Salesman with a vivid imagination and with the quality of evasion.

Handwriting and Human Efficiency

A Psychological Survey Based Upon Facts

By William Leslie French

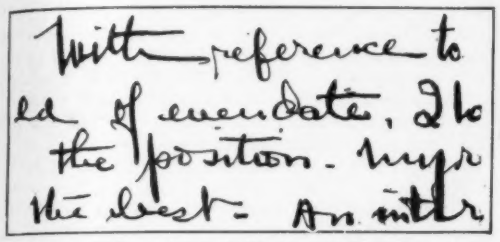
IN this country the Science of Graphology has been utilized but slightly until very recent years. And the reason for this is that its practical application to the conditions which make for human efficiency has not been tested or recognized to any marked degree. However, many who have investigated this method for analyzing character, mental and physical traits and tendencies, have absolutely become convinced of its great utility.

In this connection the evidence offered by a well-known corporation lawyer is pertinent. "Whenever it is necessary to secure complete information concerning the character and habits of witnesses," he states, "I rely particularly upon the data furnished by a graphologist in order to safeguard my clients' interests. In a recent lawsuit involving many thousands of dollars, this efficiency expert demonstrated from written records that the person under cross-examination—a prominent man—was first and foremost a liar and a crook, that his statements when called to testify would be false. Later he strengthened his remarks by proving that the witness had forged his signature. This evidence proved to be correct in detail. Within twenty-four hours this witness had fled to parts unknown."

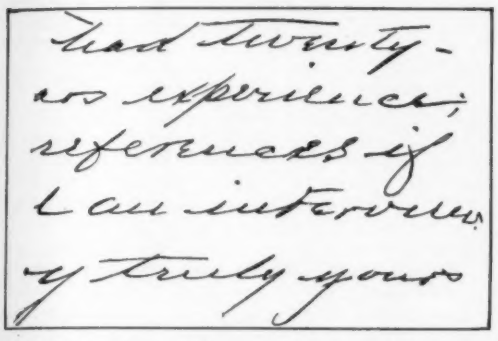
To give an illustration, a few months ago, in the office of one of our large corporations, the secretary of the firm sat opening his mail. After consigning a number to the waste-basket, he uttered an exclamation of disgust. "Well, I'll be jiggered! I advertised in the paper for a bookkeeper and these are what I get. This is one sample"—shoving a letter across the flat-top desk. "I'm not a handwriting expert, but if this fellow's writing does not show his lack of fitness, I'll resign my position. And this is not my first experience by any means. Every firm is up against the same proposition. Half the time, if the references are good, the man is crooked or given to bad habits which make him worthless in the long run."

Number three is the letter. Note the general style, irregular, careless, somewhat erratic, with the punctuation sloppy, indicating that the writer is lacking in systematic effort, the type who would cover the pages of a ledger with erasures. He blurs his strokes, being heedless of using the blotter. One might even infer that his fingers would be stained with tobacco, and his clothes soiled. The strokes of one line interfere with the others, showing that he does not think clearly, while his capital letters give an inordinate conceit concerning his ability, being flamboyant, large and sprawly. Such signs give the writer a tendency to refuse a suggestion or work in harmony with the system existing in an office. As this penmanship inclines to the right and then to the left, instability and vacillation are betrayed.

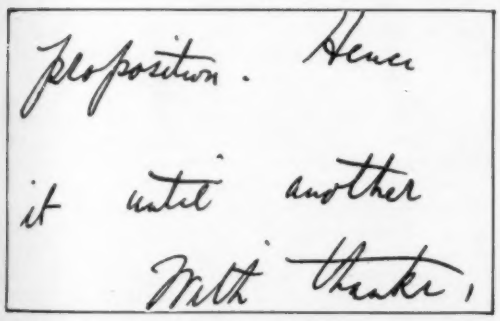
Number four is a marked contrast, as anyone can see. This individual is orderly, systematic, cautious and industrious. The style is uniform, with punctuation carefully placed and the small letters even in height and pointed at the top. The long letters are well developed above and below, the "t" crossing being



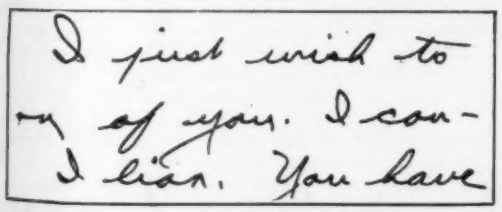
No. 3.—This writing indicates carelessness, confusion of thought.



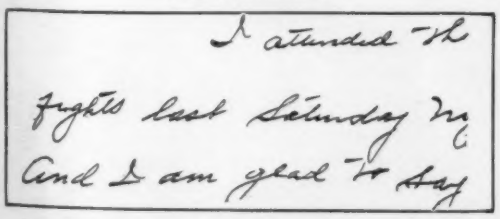
No. 4.—Order, system, punctuality are shown.



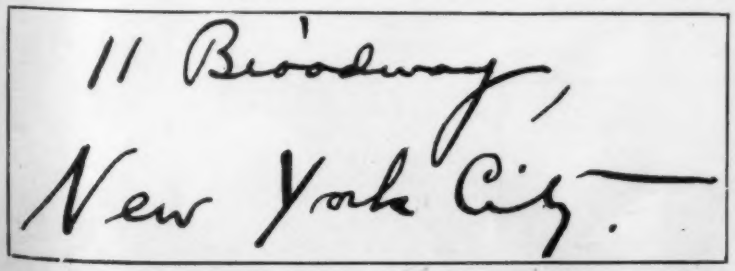
No. 5.—Clergyman with gift of raising money; type showing the qualities of an executive.



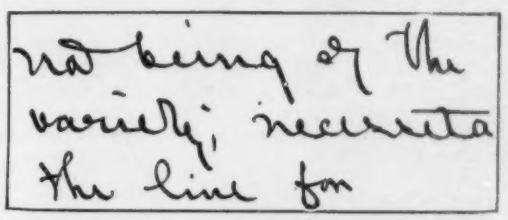
No. 6.—The writing of a crook—one who is thoroughly dishonest.



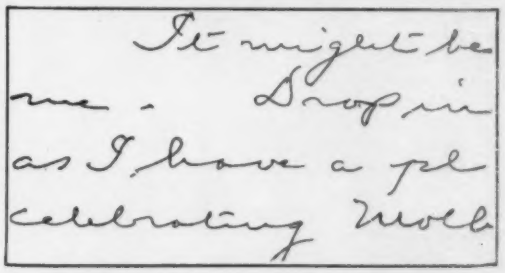
No. 7.—Craftiness, cunning, lying, and cowardice appear.



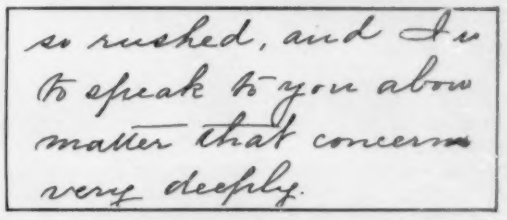
No. 8.—Salesman with resource, aggressiveness and self-confidence.



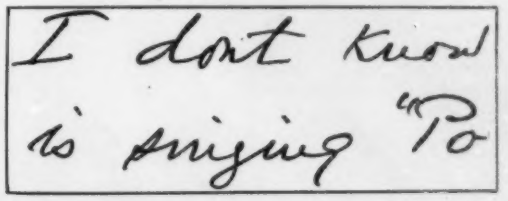
No. 9.—The liar and one using underhand methods.



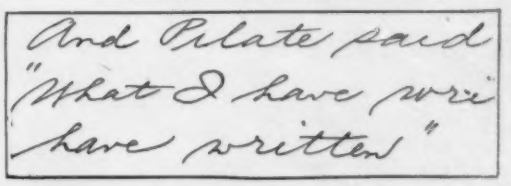
No. 10.—Type showing honesty, reliability, sincerity and ability for banking or similar work.



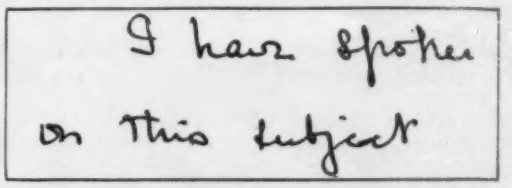
No. 11.—Woman with a straight mercantile conscience, excellent worker.



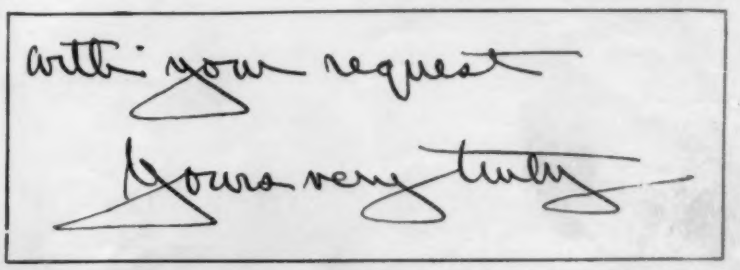
No. 12.—Excellent salesman; much assurance is shown and gift for closing a deal.



No. 13.—Gentle, type not fitted for selling goods.



No. 14.—This writing indicates mechanical and engineering inclinations.



No. 15.—Man in perfect physical condition. Note the large loops of his "y's."

neither at the right nor left of stem. A person showing these signs would be able to occupy any position which requires ability for office work, bookkeeping, banking or similar lines. He would be industrious, punctual and do his duty at all times.

Number one, the writing of a woman, betrays her forceful way of thinking, as appears in the connecting strokes, the "t" crossing and firm pressure. Her tact is found in the first small letters of words being larger at the beginning than at the end. An occasional break between letters as in "borough" gives her intuition, a valuable adjunct which many successful executives also have. A clergyman who is amazingly skillful in raising money for his projects wrote specimen five. His self-confidence, will-power and ambition, signified by the heavy pressure, "t" bar sloping downward to the right, and upward pounding of his words across the page, combined with the tact and diplomacy signs as before, force him into the executive class, despite himself, as it were.

There is a saying that he who does not write straight will not think straight, act straight, or be straight. So in the writing of number six appear all the pen-signs which mark the crook at heart. Observe that the lines undulate, the small letters varying in height and size, of which some are close together and closed. The spaces between the lines are not very even, and the finals are rather abrupt. Should the occasion arise, a person possessing these hall-marks would not hesitate to juggle petty cash, indulge in check-kiting, or take graft at every opportunity.

In specimens numbers seven and nine appear two other types of writing which throw them very closely into the same class. The signs are alike, though, as anyone can see, the style of both is markedly different. The first is a good example of a person who would be crafty, use cunning, and cover his tracks rather successfully. Though his cowardice is shown by the feeble pressure, he could lie skillfully, for his "a's" and "o's" are tightly closed, the small letters being pointed at the top. The second is another who, on account of writing backhand, has a natural tendency to deviousness, while his ability to lie shows in the looping of the "o" in "of."

How strikingly different are the scripts of numbers ten and eleven. Both individuals write a straightforward hand with no wavy movement, small letters changing in height and size, or the spacing between lines and letters uneven. Each leaves plenty of room between the letters, and the finals are not cut short. Thus, honesty, sincerity, truthfulness, frankness and adherence to duty are revealed. In any form of work, people who exhibit such pen-traits can be relied upon to perform every function without being "jacked up" by the manager of the office. Writing at the angle of forty-five degrees, the pressure being even throughout, endows such with a mercantile conscience which prevents any deviation whatsoever.

As handwriting indicates moral endowments, it also reveals the various kinds of work for which people are fitted, along commercial lines, of which the following are additional examples:

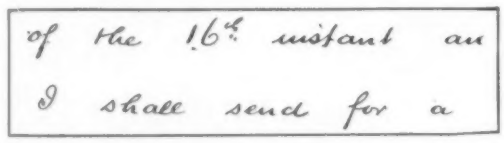
If it is necessary to engage an individual for the position of a salesman—bond, advertising, real estate or insurance—the general features found in numbers two, eight and twelve will appear. As you will note, these specimens are quite dissimilar in style, but the mental ingredients are there. Each pounds the paper with force, energy and determination, as is shown in heavy, bold, uniform pressure throughout. The big generous capitals give self-assurance, confidence and a belief in their own ability to succeed, which is increased by the high looped letters above the lines—as the "h's" in number two, the human bronco-breaking capitals "I" and "P" in number twelve. All give the writers imagination, the power to visualize the proposition which they may be exploiting, and then convince others. To be sure, they close their small "a's" and "o's," the usual sign of secretiveness, but in these cases it merely signifies that they know when to keep their mouths shut—an excellent sign in a salesman!

Anyone can see that the person who penned number thirteen has about as much self-assertiveness as an anemic kitten trying to cut down an oak. He crosses his "t's" in that quiet fashion which shows that he would present a business scheme or plan so quietly that the average man would have an engagement for lunch. The delicacy of his writing and pressure debars him from selling "blue sky," accentuated by the fact that, unlike his predecessors, his script has no curved base-line—the sign of being able to evade the question or dodge a curious and pertinent customer. This style indicates timidity. Would you care to employ this type to sell goods?

As engineering, invention and creative power play an important part with corporations to-day, it is of interest to learn what strokes in combination show capacities in these directions.

Where a person has naturally a scientific bent, you will find that the writing is, as a rule, perpendicular, backward or sloping slightly to the right. The small letters will be low, pointed at the top or square, and the connecting strokes of words and letters well formed. Frequently, they are shaped like figures or chemical signs, angular rather than rounded. (See especially number fourteen.)

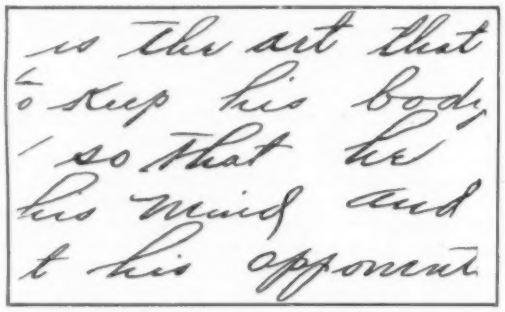
Examples fourteen and sixteen are excellent types of persons who have a natural gift for mechanics and engineering. The first gives every sign, the second betrays the same formations, but the power of concentration is remarkable besides, indicated by the small



No. 16.—Electrical engineer or one who would do well in this class of work.

precisely-formed low letters. This man's mind would apply itself to minutiæ to an extraordinary degree. In contrast to that of his companion, number fourteen, his *metier* would be electricity in preference, because of the critical investigating trend shown by the small letters pointed at the top and the sharp up and down strokes, as in "f" and "y." He does not possess as much liking for engineering problems as the other, since his "h" does not extend so far above the baseline.

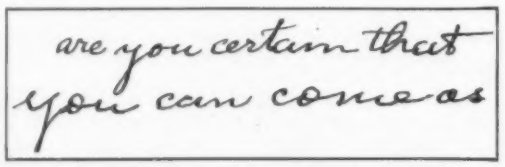
Good health is the first requirement for a man to do effective work, enabling him—all other things being equal—to hold his position and to advance. Speci-



No. 17.—This individual is a drug fiend. Formerly a fine athletic specimen. Morphine or opium fiends show the same signs.

men number fifteen presents a perfect billet of health, safe for any insurance company to pass on, for the even, steady flow of the writing, the firmness throughout, and the well-formed rounded curves below the lines, signifying a love of athletics and outdoor sports—the "y's"—all betray physical exuberance and vitality—a man who is in fine physical trim.

Now look at number seventeen, and see if to the naked eye one can spot any difference with that above. Apparently, there is the same kind of pressure, and like curves below the lines. But, unfortunately for the writer, there is the remarking of the strokes in

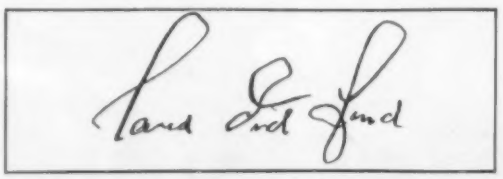


No. 18.—This specimen shows all the combinations of small "a's" and "o's," indicating secretiveness and caution.

"art," "so," and in the last half-obliterated word, reveals, under the glass, that this individual is addicted to the excessive use of cigarettes and morphine. He is a big, strong, husky fellow, naturally as powerful as a bull, but beginning to weaken. He lost his position—a good one—because he was too sluggish and sleepy. On the surface, he appeared to the average onlooker to be normal.

In reading the characters from a given specimen, the following additional rules should be observed:

Where strokes constantly appear it indicates a natural and strong characteristic. A stroke which is occasionally seen betrays an occasional trait, while one



No. 19.—The large loops of the letters above the line indicate highly developed imagination.

which appears regularly and is exaggerated shows an abnormal characteristic.

The general signs which have to be considered as the foundation of this science are the manner in which a person makes his connections, whether the writing is large, small, or intermediate, round, sharp, or angular.

Writers who make their capitals large, with the small letters high, possess a desire to do great things, are enterprising, independent, and take pride in their achievements, and are liberal in their views. They are better at generalities than fitted for detailed work. Many extravagant spenders write a large hand showing wide spaces between the lines and letters.

Small writing gives the writer concentration and the power of attention to details, with carefulness, a fine sense of observation and a good critical faculty, especially if the letters are sharp at the top. The capitals may be either small or large, for their height has a different significance, which will be touched on later.

Where the small letters are neither too high nor too low—the intermediate class—the individuals are well balanced, usually, with the qualities of good judgment, intellectual and material order, a fair amount of concentration, and practical common sense. But the reader must remember that other signs may modify these traits.

People whose writing is sharp, with clear-cut corners, have much power of resistance, some of their traits being rudeness, severity, excitability and temper. Those who pen a well-rounded hand show the opposite characteristics. Mildness of disposition appears, and such writers are easily influenced by others, their power of resistance being less.

An individual who reasons clearly, showing a logical mind, will form his connecting strokes carefully and even with a good deal of originality, there being practically no breaks between the letters of words. Sometimes there are additional signs, such as words being connected, also. The strokes of one line will not interfere with the others, while a fixed style will be shown.

The slope of the writing is a most important feature, for according to the slant you can determine the amount of affection an individual possesses. The normal slope is close to forty-five degrees.

The "t" dashes play an important part in affecting a person, character, and disposition. In many cases they are the sign of temperament.

If the stroke is long, running upward, ambition, zeal, love of enterprise, and enthusiasm are signified. Mental energy appears when the crossing is dashed to the right, frequently downward. When the "t" bar is blunt stubbornness is betrayed, the man who will hang on and stick to his purpose. A long steady stroke across the "t" stem shows deliberation and moderation. Will power also appears. A weak, flabby stroke betrays vacillation and little will to achieve, the person being easily influenced.

The capital letters are also very significant. When the capitals are very high and large this shows conceit and vanity, and these qualities are exaggerated if flourishes appear. The lower the capital the less pride there is. If the first stroke of the "M" is higher than the others, independence, pride and social ambition are shown. This applies to the "N" and "W" also. When the outlines of the capitals are well formed and not too elaborate, simplicity; and artistic ability is shown by curved and print-like formations, usually shaded.

The final strokes of letters give much valuable information, and are one of the most valuable clues to character. Abrupt finals show selfishness. When they curve upward and outward, generosity and sympathy. A terminal stroke ending in a hook betrays perversity, one which would cause the writer to insist on his own ideas being carried out. A straight down stroke at the end of a word shows secretiveness and also a tendency to be skeptical.

The small letters also have a special significance, and for convenience sake can be thus classified:

a. Long letters which extend far above the baseline and are looped, especially "l's," "d's" and "f's," give imagination, also an interest in things pertaining to the mind rather than practical affairs. The looped "t's" and "d's" give garrulity, and if open at the top they are the sign of extreme talkativeness. The sharpening of long letters in this connection betrays reserve, and sarcasm, especially when the "l" is pointed. (Number eighteen.)

b. When the letters, such as "y's," "g's" and "p's," extend well below the baseline they reveal, when firm or made with a rounded curve to the right, excellent vitality and a good constitution. My interpretation does not agree with some authorities, but I have always found it to hold good.

Whenever the "a's," "o's" and "g's" are tightly closed, secretiveness and caution are found; when they are open at the top the tendency to talk too much is shown; and when they are looped—lying. (Number nineteen.)

The backward stroke to the left of the "d," or, in fact, any stroke of this formation shows sensitiveness. (Number nineteen.)

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

Snake Imbedded in a Log

To the Editor of the SCIENTIFIC AMERICAN:

One day recently my sawyer while quarter sawing a 48-inch white oak log, found a snake about one half inch in diameter imbedded near its center. The wood was sound and at first it was a perplexing question how a snake fully equipped for business had come there, but after investigation, I reached a satisfactory conclusion concerning it. It appears that when the tree was some three feet in diameter, a fire had been placed about its roots and this had partly killed one side to the height of about two feet above the stump, but a new growth had completely covered the wound. In felling the tree the dead part, being perfectly sound but brittle, suddenly gave way and splinters from the live part, some of them three or four feet long, adhered to the stump. The snake, no doubt, entered the log through the space made by the splinters, and was not able to extricate itself. The dampness of the river bottoms aided by heavy rains caused the seasoned part at the end of the log to expand and thus entirely closed the aperture through which the snake had entered.

Florence, Ala. DELOS H. BACON.

The Destructive Effect of Bullets

To the Editor of the SCIENTIFIC AMERICAN:

Quoting from the article "The Other Side of War," on page 162 of the August 30th issue of your esteemed publication, the assertion that, owing to increased rotation, the bullet acts not only as a club, striking a heavy blow, but also as a gimlet which lacerates the tissues, seems to stand in need of correction.

In order to produce a gimlet effect, the bullet must either have the shape of a gimlet or it must describe a spiral during the act of penetration. The former is out of the question, considering that the ridges made on the circumference of the bullet are trifling and run almost parallel with the length axis. Moreover, if we investigate how many turns a bullet makes in perforating a human chest of say 9 inches diameter, the answer will be surprising to anyone thinking only of the enormous number of revolutions which the bullet makes during the *whole* path of its flight. As far as I have been able to inform myself, there is not a single small-caliber gun in existence, whether rifled at a uniform or increasing twist, which would permit the bullet to make more than 1¼ turns within the barrel, i. e., for an average path of about 36 inches.

Since the rotational velocity of the bullet cannot possibly increase after the bullet has left the gun, but, on the contrary, decreases rapidly as the bullet proceeds, it follows that the bullet, in perforating 9 inches of a human chest, has made *one quarter of one turn* within the chest! How can that produce or materially affect the laceration of the tissues?

In my mind the action of a rotating bullet could be better compared with that of an awl, which as everybody knows can be passed with less effort through, e. g., a number of layers of leather, if we rotate the handle. But the hole thus made would, if anything, be smoother than if we were to omit rotation.

If, therefore, wounds made by small-caliber, high-velocity bullets exhibit any particularly destructive effect, it must be due to causes other than "gimlet action" of the bullet. Of these causes, one of the most plausible has been omitted in the explanation of Dr. Helme, to wit, incompressibility of liquids and semi-liquids. If a high-velocity bullet enters the cranium, the addition of the volume of the bullet to the (nearly) incompressible contents implies a sudden increase of pressure within the cranium, possibly the equivalent of many atmospheres of pressure, which, though lasting only an instant, is capable of fully explaining the destructive effect. Similar conditions prevail in the case of the human bladder and all other so-called cavities of the human body. Contrary to the popular belief, excepting only such pathologic conditions which have caused the formation of gases, the bladder never contains air *and* liquid, but expands in proportion as the liquid accumulates. If the liquid is voided, its walls collapse and are in a state of closest approximation.

If a bullet enters a filled bladder, the inertia of the walls prevents a correspondingly rapid expansion; hence, the destructive effect of the sudden and enormous increase of pressure within the bladder.

Beyond the well-known advantages of a flatter trajectory, the avoidance of so-called "windage," and, possibly, the avoidance of "tumbling" of the bullet, the rifling of guns, and with it the rotation of the small-caliber bullet, does not add to the "cruelty" of the wounds made. A. SIGMANN, M.D.

Pittsburgh, Pa.

The Ten Greatest Inventions

WHAT are the ten greatest patentable inventions of the past twenty-five years? The Inventors Prize Contest which closed on September 1st brought in a large number of essays, but no two agreed on the ten greatest inventions. The wide divergence of opinion is shown by the following list, taken from a selected dozen of the essays. Furthermore, a poll of the editorial staff failed to show perfect unanimity on more than six inventions. The Editor is interested to know the opinion of readers of the SCIENTIFIC AMERICAN on this subject and invites every one to send in his vote. Here is the list, and quite evidently it includes some that are not patentable, and some that do not properly belong within the 25-year period; but the reader must decide for himself which should be avoided on that score:

Acetylene gas from carbide.
Aeroplanes.
Automobile.
Burbank's works.
Calculating machines.
Color photography.
Concrete (reinforced).
Cyanide process.
Dictograph.
Diesel engine.
Dirigible.
Electric car.
Electric furnace.
Electric welding.
Fixation of nitrogen.
Flexible photo-film.
High-speed steel.
Incandescent electric lamp.
Induction motor.
Internal combustion engine.
Kodak.
Liquid air.
Mercury vapor lamp.
Monorail.
Motion pictures.
Pasteur's work.
Phonograph.
Photo-engraving.
Picture telegraphy.
Pneumatic tire.
Producer-gas.
Preservation of sugar-producing plants.
Radium.
Submarine boats.
Transmission and transforming of alternating current.
Tungsten lamps.
Turbine (steam).
Welsbach burner.
Wireless telegraphy.
X-ray machine.

Pick out the ten best inventions in the list and send them to the Contest Editor before the 18th of October. The result of the vote will be published in the SCIENTIFIC AMERICAN of November 1st. This number will also contain the essay winning first prize and the announcement of the successful contestants.

Two Trips Around the World

EVER since the time of Magellan, the journey around the world has held great attractions for travelers, and with the development of steam navigation, transcontinental railways, and all the modern auxiliaries of locomotion, the time required for the trip has been continually reduced.

Nearly fifty years ago Jules Verne created the character of Phileas Fogg, in his story "Around the World in Eighty Days," and since that time this imaginary trip has been followed by actual journeys of briefer duration.

The desire for speed, however, seems to have reached a limit, and although it is probable that still further reductions may be made in the time required to make the circuit of the globe, the relation of the duration of the journey to its value may well cause the question of real usefulness to be raised.

In particular we may mention two voyages around the world, the latest having been made by a nimble American journalist during the present year, and occupying about five weeks, and the earlier one made eighty years ago, by a young man of twenty-two, and occupying five years. The former traveler had the advantages of the modern high-speed ocean steamship, both on the Atlantic and on the Pacific, besides utilizing the trans-Siberian railway, the railroads of Korea and of Japan, and the special efforts of the transcontinental railroads of the United States. The latter made his entire trip in one vessel, the voyage having the original object of carrying Greenwich time to many islands of the sea and thus enabling their precise longitude to be determined; but the voyage of the "Beagle" will always be remembered because Charles Darwin was on board, and because the fruits of that trip around the world were the "Voyage of a Naturalist" and "The Origin of Species."

It is not how rapidly a man travels, but what he sees, and the use he makes of his observations which give the true value. A study of the time tables of railways and steamship lines would have given all the information which the later of these two journeys has thus far produced; while the consequences of that earlier and more deliberate voyage are continuing, in an ever-growing magnitude, for the enlightenment of mankind.

Harmsworth Trophy Retained by England

THE British motorboat "Maple Leaf IV," owned by E. Mackay Edgar and representing the Royal Motor Yacht Club, won the British International Motorboat trophy, known as the Harmsworth Cup, in a series of races concluded on September 12th, over a course in Osborne Bay, Isle of Wight. The "Maple Leaf" won two out of three races, and thus retained for Great Britain the trophy which she won on Huntington Bay, Long Island, last year. America was represented by the "Ankle Deep." She finished second. H. Hollingsworth's "Crusader," a British entry, was third. The course measured 32.4 nautical miles. It was covered by the "Maple Leaf IV" in 40 minutes and 10 25 seconds; by the "Ankle Deep" in 43 minutes and 25 seconds, and by the "Crusader" in 46 minutes and 30 2/5 seconds.

The Motor Tank Ship "Hagen"

THE trial trip of the new motor tank ship "Hagen" showed some interesting figures as regards fuel consumption. It will be remembered that this first large mercantile motor vessel (2-cycle motors) built at the Krupp Germania yard at Kiel is one of three vessels contracted by the German-American petroleum company. Two are sister ships of 8,350 tons dead weight capacity and 3,000 brake horse-power, while the third will have 15,000 tons capacity and 4,000 horse-power. The "Hagen" is one of the smaller vessels, 400 feet in length, 53 feet breadth and 32 feet 4 inches depth to upper deck, being a twin-screw ship with two 6-cylinder sets of engines of 1,500 horse-power each. The delivery trip—rounding the Skaw and in the North Sea—took place from March 15th to 19th, and measurements showed the oil-consumption of the main engines at 1,050 brake horse-power (1,500 indicated horse-power) to be only 0.424 pounds fuel per brake horse-power-hour (0.297 pounds per indicated horse-power), including the fuel consumption of one of the motor compressors for injection air. In spite of liberal lubrication on this first sea trip, not more than 13 pounds of lubricating oil per hour were used for the whole engine plant, and in the future this will naturally be decreased. With 2,100 brake horse-power total, the ship attained 11 knots, and at 2,700 horse-power (3,800 indicated horse-power) it increased to 12½ knots. As far as is known, 4-cycle marine engines of equal power burn 0.32 pounds per indicated horse-power (the "Hagen," as above, uses 0.297 pounds). Thus the drawback of increased consumption till now looked upon as associated with 2-cycle engines did not occur in the "Hagen," and the great advantages of the 2-cycle engines over 4-cycle did not have to be paid for in extra fuel.

The E. H. Harriman Memorial Gold Medal

TO create a better understanding on the part of the public in what the railroads are doing to make safer conditions of travel and to safeguard their own personnel, through the prevention of accidents, Mrs. E. H. Harriman has offered a gold medal annually, to be awarded by the American Museum of Safety.

In announcing the gift, Mrs. Harriman states:

"To stimulate a direct effort for the conservation of human life, it gives me pleasure to place at your disposal the E. H. Harriman Memorial Gold Medal, founded by me, to be awarded annually by your board to the American steam railway making the best record in accident prevention and industrial hygiene affecting the public and its own personnel during each current year."

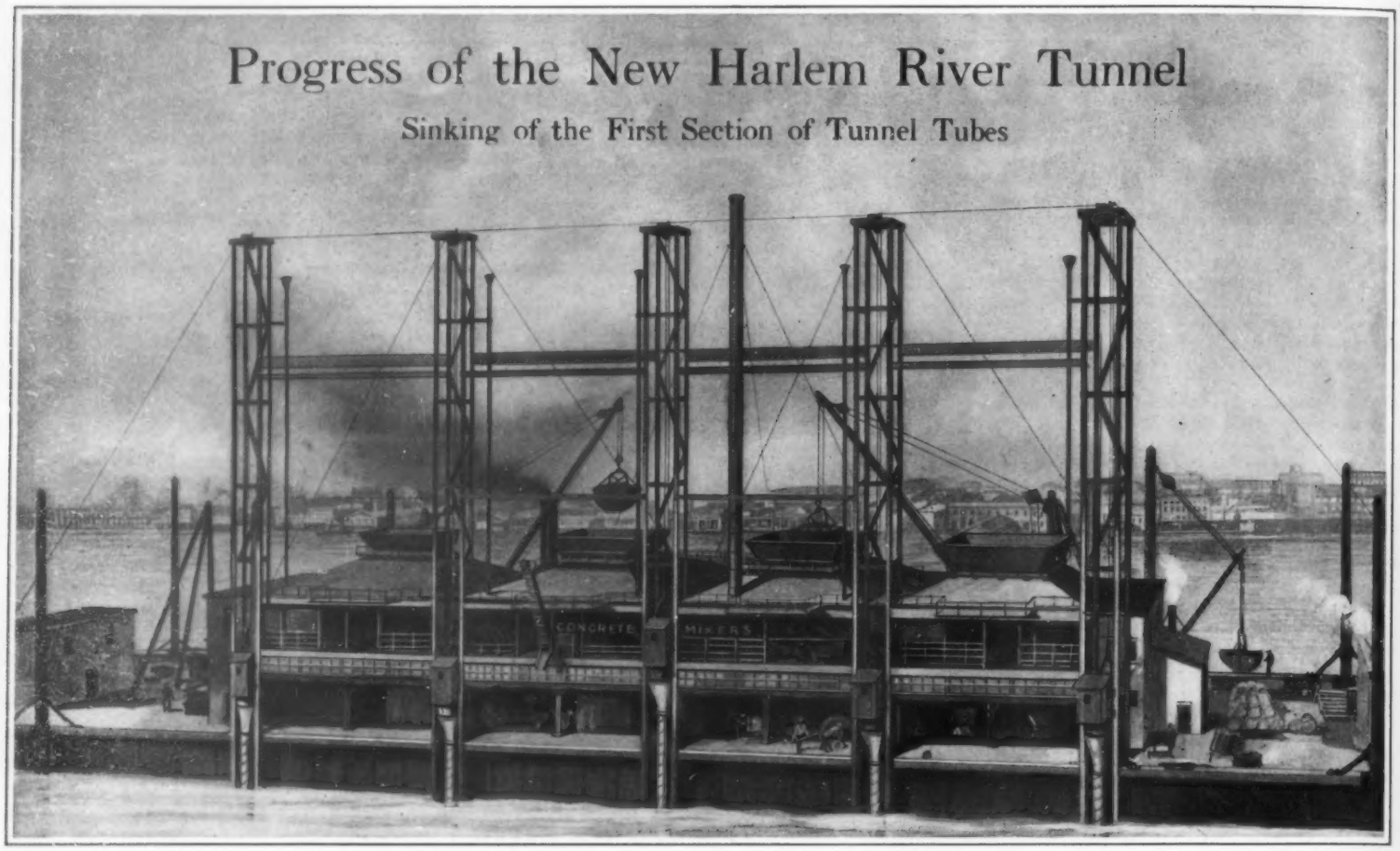
The gold medal will be awarded to the railroad company itself, a replica in silver to the member of the operating department of that road who has done the most to bring this condition about, and a replica in bronze to the employee of the winning road who was most conspicuous in the promotion of safety by suggestions or otherwise.

The Current Supplement

AN important article in this week's issue of the SCIENTIFIC AMERICAN SUPPLEMENT, entitled "Letters Patent in Relation to Modern Industrial Conditions," comes from the pen of F. B. Fish, one of the foremost patent lawyers in this country.—H. E. Ives and M. Luckiesch have investigated the distribution of luminosity in nature. Their report appears in this week's SUPPLEMENT.—Mr. T. G. Dalal contributes a handsomely illustrated article on the White Marble Temples of Dilwara, the exquisite carving of which equals anything that the western world can show.—Some time ago Prof. Hale of the Mt. Wilson Solar Observatory investigated the magnetic field of sunspots. More recently he completed a similar study of the much weaker general magnetic field of the sun as a whole. This brilliant investigation, in which use is made of the fact that a magnetic field produces certain alteration in the lines of the spectrum, is of interest not only in its relation to the sun, but also on account of the light which it sheds on the probable cause of terrestrial magnetism.—Sir Oliver Lodge's address is concluded in this issue, its closing paragraphs being devoted to psychical research and the question of the survival of the soul after death, a subject on which the great English physicist holds original views, as our readers know.

Progress of the New Harlem River Tunnel

Sinking of the First Section of Tunnel Tubes



The "tremie scow" with which concrete is deposited on the tunnel.

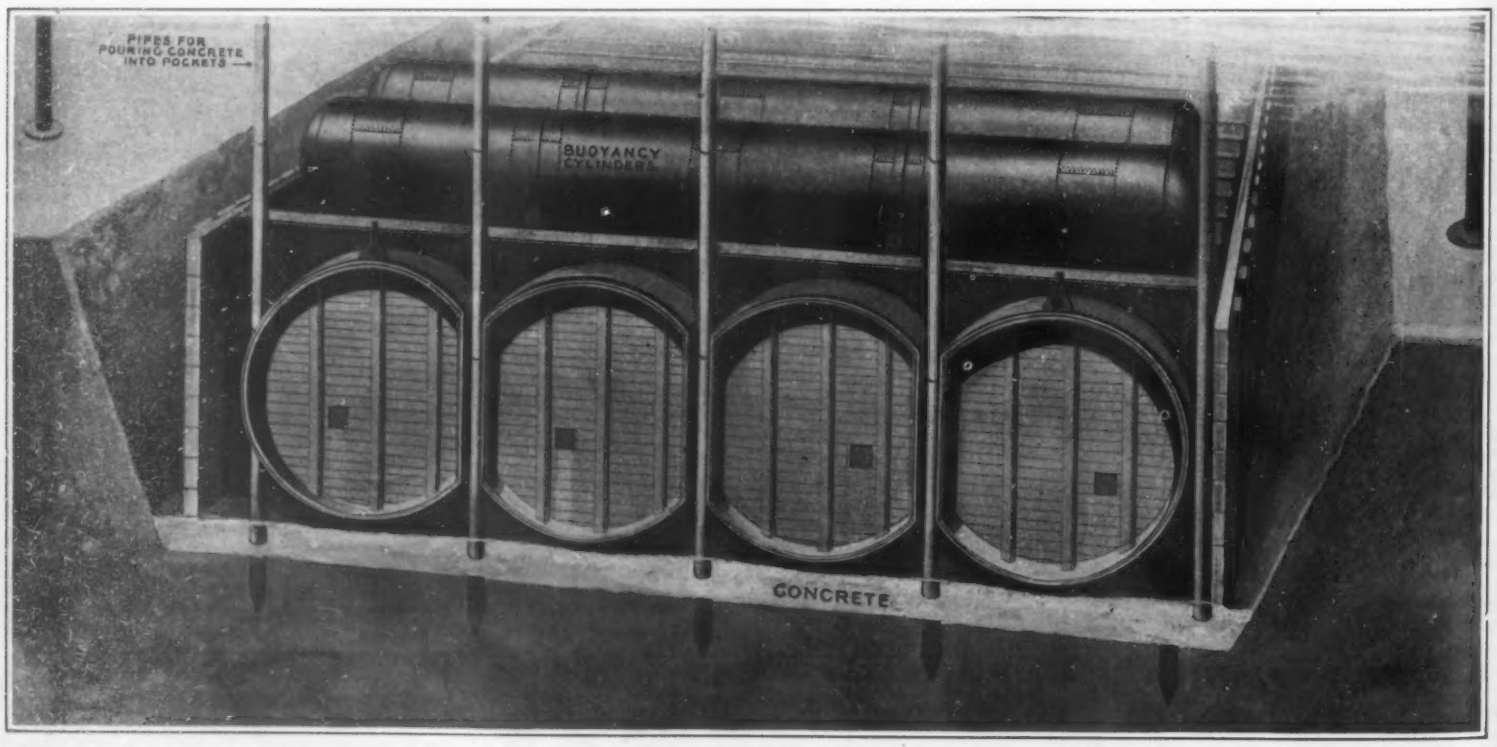
IN the SCIENTIFIC AMERICAN of March 29th, 1913, we told how the four-track tunnel of the Lexington Avenue subway was to be constructed under the Harlem River, and illustrated the article with drawings and photographs of the Detroit River tunnel, which was built in a very similar manner. It was thought then that the work would soon be under way, but it was delayed owing to inability to obtain the steel for the tubes. Now that the actual laying of the tubes is in progress and one of the sections has been sunk, a *résumé* of this interesting system of tunneling may not be amiss.

It will be recalled that the general method of procedure is to dredge a trench across the bed of the river, and in this lay the four tubes of the tunnel, afterward covering them with concrete and then fitting them also with a lining of concrete. The total length of the tunnel will be 1,080 feet, and it will be laid in five sections, four 220 feet long and one 200 feet. One of the 220-foot sections has now been laid, and is being concreted.

The tubes as shown in the accompanying illustrations are flat at their contiguous sides and are connected by transverse plates or diaphragms of quarter inch steel which hold the tubes in rigid relation to one another while they are being sunk, and also provide the necessary steel reinforcement for the concrete that is to be laid over them. The diaphragms project well beyond the tubes, and join the timber side walls that inclose each section. The diaphragms are placed 15½ feet apart, and between them pockets are formed in which the concrete will be laid.

To prepare a temporary foundation for the section just sunk, bents, consisting of pairs of piles connected across the top with a head-piece of channel steel, were sunk in the trench already dredged across the bed of the river. Each bent was carried down to the exact grade by means of two pile drivers. Five bents were sunk at each end of the section. They projected a foot or two above the bottom of the trench, and served merely as a temporary support. The material at the bottom of the trench is very closely packed gravel which forms an excellent foundation for the tunnel.

The four-tube section was assembled on a staging about a mile from the site of the tunnel. When the section had been completed, and it was ready to be sunk, a series of long narrow scows was introduced between the longitudinal rows of piling of which the staging consisted. As the tide rose, the scows lifted the section off the piling, and it was then towed out into stream. At one end of the tube section the ends of the tubes were closed by means of substantial bulkheads which were built doubly strong as they are to withstand the hydrostatic pressure while the tunnel is being lined with concrete section by section. At the opposite end of the tube section only the two outer tubes were fitted with bulkheads, which were lighter because they were to be used only to prevent too rapid



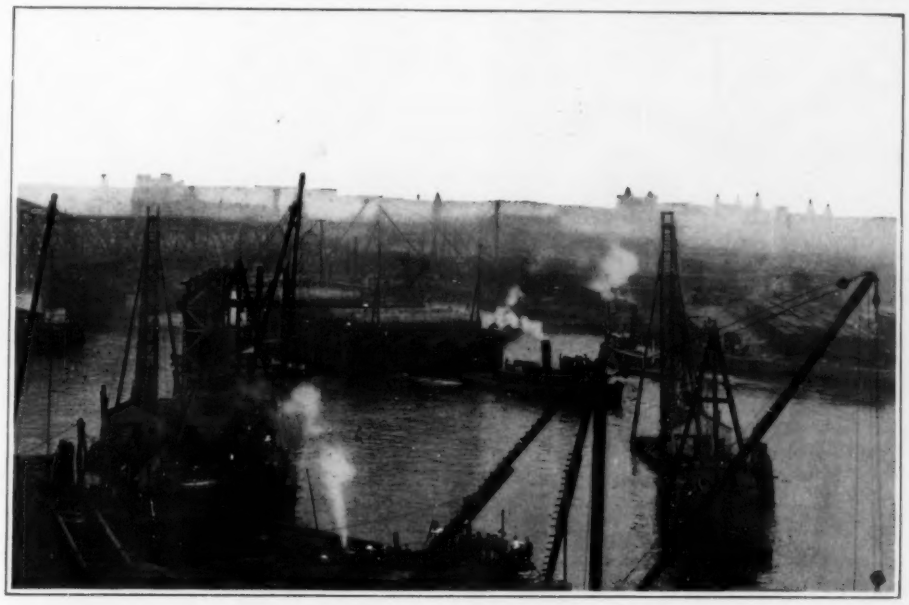
Laying a bed of concrete under the tunnel section before removing the buoyancy cylinders. Note that the mouths of the tremie pipes extend below the surface of the concrete laid.

a flooding of the tubes. The inner two tubes were provided with partial bulkheads to keep out the water while the tunnel section was being towed to position. After the section had been floated off the piling, the scows were scuttled, leaving the tunnel section afloat. The floating structure was then towed down to the site of the tunnel. It was decided to start sinking the sections at the middle of the river rather than at the shore ends. Half of the river was accordingly blocked to navigation and piles were driven between which the tunnel section was guided and accurately centered.

When the first section of the Detroit River tunnel was sunk it plunged endwise instead of settling down evenly. Secured to the top of the tunnel were four buoyancy cylinders, two at each end, adapted to support the tunnel section after it had lost its buoyancy, but as there were no partitions dividing the tubes, a slight tilt was accentuated by a rush of water toward the lower end. To be sure it righted itself immediately after it had plunged far enough to submerge the buoyancy cylinders, but there was danger of straining the construction. To overcome any such tendency in the Harlem River tunnels, the section was provided near the heavier end with partial bulkheads, extending halfway down from the upper part of two of the tubes. As the tubes filled with water, the heavier end tipped downward until the lower edge of the partial bulkheads touched the water. Then the air trapped back of these bulkheads buoyed up that end until the tunnel section came to an even keel. The trapped air was allowed to escape through hose running to one of the barges, where it was controlled so as to keep the section on an even keel. When the tunnel section had been sunk to within about a foot of the top, it lost its buoyancy and sank abruptly until the buoyancy cylinders strapped across each end came into contact with the water. These buoyancy cylinders were each provided with a central chamber into which water was admitted, until the tunnel section sank beneath the surface. Two derricks then took the strain, which amounted to about five tons altogether, and lowered the section slowly until it rested upon the bents. The section was fitted with four masts, each bearing a target, so that by means of level and transit it could be brought into accurate alignment with the line of the tunnel. This was done with extreme accuracy, and the tunnel section, heavy as it is, is not more than ¼ of an inch out of the true position.

The method of laying the concrete under water was fully described in the issue of March 29. A large scow fitted with concrete mixing machinery is provided with five towers so spaced that when the scow is brought into position transversely over the tunnel section, "tremies" may be lowered from them between and at each side of the tunnel tubes. The tremies are provided at their upper ends with hoppers adapted to receive liquid concrete. The first charge of concrete is relatively dry and is adapted to force out the water in the pipes. Thereafter the concrete dropped into the pipes is quite liquid. The ends of the tremies project below the surface of the concrete already deposited so that the latter will form a cover to exclude the water. As fresh concrete is added this cover will float and protect the fresh concrete from the action of the water. This system was employed in laying a concrete bed for the tunnel section after it was sunk so that each of the diaphragms would support its share of the load. The buoyancy cylinders were then removed, and at the present writing the work of filling the pockets with concrete is nearing completion. When the next section of the tunnel is sunk, it will be connected to the present section by means of divers. When all five sections of the tunnel have been laid and concreted, bulkheads will be built around the ends of the tunnel and the water will be pumped out to permit of connecting them with the land section of the subway.

We are indebted to Mr. Olaf Hoff, the inventor of this system of tunnel construction, for the accompanying photographs.



Towing the first section of the new Harlem subway tunnel to position over the trench previously excavated in the river bed.

The tunnel section filling with water and slowly sinking. Note the four masts bearing level and transit targets.

Bringing the Sea to Miraflores Locks

ON the morning of the last day of August, this year, the detonation of 36,000 pounds of 45 and 60 per cent dynamite opened a breach in a rock-and-earth fill which had been made across the prism of the Panama canal about a mile from Miraflores locks, and completed the eight miles of sea-level canal from Miraflores to the Pacific.

The duty of this dike was to exclude the water of the completed portion of the canal from the huge excavation in which the concrete masonry of the Miraflores lock was being laid. The dike also rendered it possible, without having to wait for the completion of the locks, to complete the sea-level approach to the canal down to its full depth of 45 feet, by means of the economical floating dredges. The dam was thrown across the canal prism some five thousand feet to the south of the locks, and this stretch of a mile or so was excavated in the dry by steam shovels. The Miraflores locks are completed and the gates have been hung in position; so that there was nothing to prevent the canal builders from permitting the Pacific Ocean to ebb and flow right up to the entrance gates at the seaward end of the locks.

In preparing for the blast, 541 three-inch holes were drilled vertically into the dam to an average depth of 30 feet, and the 18 tons of dynamite was distributed among them. The conditions at the time of and after the explosion are very lucidly described in the current issue of the *Canal Record*—a Government weekly publication issued under the editorship of Mr. Bucklin Bishop, which, during the building of the canal, has most admirably fulfilled its purpose of keeping the general public in touch with the progress of the construction of the great work.

At the time of the explosion, the water in the channel south of the barrier was nearly at low tide. The dynamite tore a gap in the dike about 100 feet in width; but as the bottom of this rent was still at some height above the existing tide level, no water passed through. At about half past one on the same day, however, the water in the sea-level channel had risen nearly to the top of the dam. A man with a shovel then opened a small trench across the dike, through which a slight stream of water began to flow. Under the cutting action of the water, the opening rapidly increased in size, until, some forty minutes later, a great torrent of water was pouring through an opening 30 feet wide, with a fall of some 30 to 35 feet. The rush of water, says the *Record*, ate away the sides of the opening steadily, carrying large sections of the dike, including the trestle from which the dike had been built, together with other débris, into the excavated section of the canal between the dike and Miraflores locks. The pit was filled rapidly, and at 3 o'clock, or one hour and twenty-five minutes after the first small stream was opened by the workman's shovel, the level in the inside channel was the same as that of the outside channel, the gap meanwhile having been opened to 400 feet or more.

Two dredges are now at work on opposite sides of the dike removing what is left of it, and by October 1st it is expected that large ships will be able to steam up through the Pacific end of the canal for a distance of eight and one half miles to the locks. As a matter of historic interest, our readers may like to know that the launch "Birdena" was the first vessel to pass through this section of the canal under its own steam, which it did on Tuesday afternoon, September 2nd.

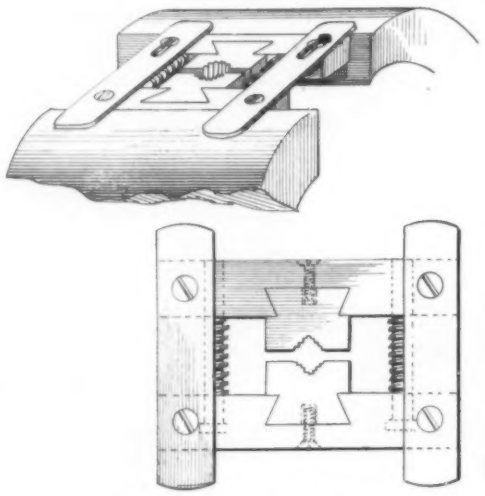
Of our two illustrations, one shows the mass of débris in the air and falling into the water a few seconds after the explosion; the other, taken later, is a view looking from the seaward end of the Miraflores locks and showing the tidal waters of the Pacific filling the approaches.

The Annual Report of the Mississippi River Commission for the fiscal year ending June 30th, 1912, published as an appendix to the report of the Chief of Engineers, United States Army, is especially interesting for its official statements concerning the great floods of last year. From comparisons of gage readings the Commission says: "It seems obvious that reservoirs at the tributary headwaters would not have been effective in preventing the flood in the Mississippi River below Cairo." The report discusses again the prevailing belief that floods are caused by the elevation of the river bed due to the construction of levees, and repeats its conclusion that there has been no progressive elevation of the river bed.

Handy Vise Tool

By I. B. Spittel

FOR small work that cannot be held in the vise alone the tool illustrated in the accompanying drawing will be found very convenient. It consists of two pieces of cold rolled steel, ¾ inch square by 4 inches long, connected at each end by screws which are threaded into one of the pieces and slide freely in the other. They are also connected by straps secured thereto with flathead screws. At one end the screws pass through slots in the strap to permit of a limited amount of movement of the two pieces of steel toward and away from each other. The strap projects beyond the edges of the steel pieces, so that when the tool is placed in the vise, the projecting ends will rest on the jaws of the vise, as shown. Secured in each of the steel pieces is a block of hardened steel formed with a toothed V groove to grip round surfaces readily. On each of the connecting screws is a coil spring adapted to spread the members apart. The work may be temporarily held in the tool by closing the blocks or jaws on it and clamping them by tightening the screws in the straps. Then the tool is placed in the vise and the vise jaws may be tightened to grip the work more securely.



Tool for holding small work.

Oxidized Carbon Plate

By "Delta"

IF a carbon plate, or preferably a number of carbon plates arranged in series in a set of cells with lead cylinders for the negative terminals, and a mixture of one part sulphuric acid to eight parts of water for the electrolyte, be subjected to a current of ten or more amperes, hydrogen gas will be given off copiously from the lead cylinders, while the oxygen that is generated will become absorbed and possibly partly combined with the carbon plate. It is best to arrange the cylinders of sheet lead with leaden hooks bent over the upper edge of the vessel, and supporting the cylinders so that there is a clearance of about an inch from the bottom of the cells. The cells should be filled to within about an inch of the top with the dilute sulphuric acid. After the carbon plates have been charged for about twenty minutes, they should be dipped into hot water to free them of any acid remaining, and then should be dried. Upon an examination, it will be found that the color of the carbon plate has become changed from the usual graphite color to a coffee brown all through that part that has been submitted to electrolytic action. If a test be made of the carbon in a battery, it will be found that the cell is far more powerful in its action than with untreated carbon. The porous cup as well as the peroxide of manganese and granulated carbon, which is used mainly as a depolarizer, may now be dispensed with, and hence the internal resistance of the cell will be lowered considerably. As the carbon surface has been roughened by the electrolytic action, not only is the negative surface increased, but the tendency of the free hydrogen to cling to the surface is overcome, for the oxygen of the oxidized plate combines with the hydrogen to form water. Cells with carbon plates treated as described have been found of use for intermittent service as, for instance, in the batteries of electric cells and nickel-in-the-slot machines, where the vigor of the cell is so improved that the number of cells in the battery may be reduced.

If a dozen carbons be treated in series as shown in the illustration, it will be found, upon disconnecting the current, that the cells form a powerful storage battery, capable of giving a considerable amount of energy in return. This was discovered by the author when oxidizing a set of carbons for dry cells.

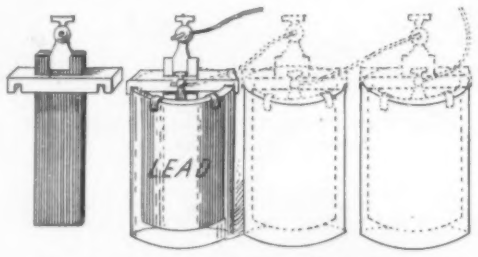
An Electrolytic Rectifier for the Garage

THE cheapest and simplest electric lighting system for the automobile to-day is the straight battery system, in which a storage battery is carried on the running board or under the seat of the car, and is connected to the head, side, and tail lights through switches on the dash.

Such a battery, which is usually of 80 or 100 ampere-hour capacity, must be charged regularly from some source of power.

If the owner of such a system has a 110-volt alternating current circuit in the garage, or has access to such a circuit, the following rectifier, which may be constructed for an expenditure of a few dollars, will enable him to charge his lighting or ignition battery from such a source.

The first and most difficult part of the set to construct is the transformer. The core of this consists of a standard ten or twelve pound coil of No. 22 B. W. G. soft iron wire. This coil is first soaked thoroughly with shellac, care being taken to see that all binding wires or wires which run at right angles to the main convolutions of the coil are removed. This is to cut down eddy current loss. The coil is then placed in the oven of a stove and gentle heat applied until the shellac is baked hard. The coil is then taped with three layers of half-inch plain cotton tape, wrapped spirally for about two thirds the circumference of the coil. This tape is then shellacked.



Arrangement of cells for oxidizing carbons.

Upon this taped core the primary winding is now wound. This consists of eight hundred turns of No. 22 B. & S. double cotton covered wire, from two to two and a half pounds being required. This should be put on in four layers of two hundred turns each. Each layer should receive a coat of shellac and a covering of one layer of the cotton tape. In winding the transformer, the iron wire core should be clamped in an upright position on the edge of the work bench, so that the spool of wire may be passed through the center and over the outside without difficulty. Care should be taken when purchasing the wire for the transformer to see that the spool containing it is small enough to pass freely through the center of the iron wire coil. It will be found that the ordinary three and five-pound spools will do this without any difficulty. Care should be taken in the winding operation, to see that the turns of wire lie closely adjacent to each other on the inside of the coil, and are spaced apart on the outside, in order to compensate for the difference between the interior and exterior diameters of the core.

When the primary has been completed, the ends should be soldered to two short pieces of flexible lamp cord for terminals, and the whole winding covered with three layers of the cotton tape. The transformer at this stage should receive another coat of shellac and a second baking, care being taken to see that the coil does not become hot enough to burn the insulation.

The secondary winding is now wound in place directly over the primary. The secondary consists of two hundred and forty turns of No. 16 B. & S. double cotton covered wire. This will require from a pound to a pound and a half of wire and should be wound on in two layers. A tap of lamp cord should be soldered on at the middle of this winding, the secondary thereby comprising two sections of one hundred and twenty turns each. The two outside ends of the coil should also be provided with the flexible leads and the shellacking and baking process again repeated. It should be stated in connection with this baking, that the same should be thoroughly done as all moisture must be driven out of the transformer before it is used, or it will overheat badly. This overheating should be watched for the first few times the transformer is used, care being taken not to let it become too warm. Any heating up, however, will have the effect of drying out the windings, and after it has been used a few times, the transformer may be left in circuit continuously as long as desired. The completed transformer is shown in Fig. 1, the large number of secondary taps shown in this figure being brought out from the winding for experimental purposes.

The next part of the outfit to be constructed is the rectifier itself. The parts needed for it are as follows: Two enamel ware buckets of about two gallons capacity each, four pieces of sheet iron, five inches wide by six inches long; two pieces of 1/16 inch aluminium, three inches wide by seven inches long, and two pieces of hard wood strip about one quarter inch thick, one half inch wide, and two feet long. The iron plates should have holes drilled or punched in the upper corners of each pair, and the aluminium plates should have a single hole drilled in the middle of the top edge to receive a binding post or brass machine bolt and nut.

The two strips of wood are laid together with the two aluminium plates between them, spaced about sixteen inches, center to center. An iron plate is then placed on the outside of each wooden strip, directly opposite an aluminium plate, and holes are drilled through the wooden strips to register with the holes in the iron plates, and the whole bolted together with brass machine bolts inserted in these holes. This portion of the rectifier may be seen in Fig. 2, resting across the tabs of the two pails. This figure shows the complete rectifier in use charging a 100 ampere-hour lighting battery.

Two pounds of sodium phosphate is placed in each pail, and the pails are then filled with warm water. After this cools, the rectifier may be connected up as shown in Fig. 3. In the figure *A* is a double pole two ampere fuse block to which the 110-volt circuit is connected. *B* is the transformer, the two windings being shown on different parts of the core for clearness. *C C* are the two rectifying cells, and *D* is a double pole six ampere fuse block to protect the battery which is shown at *E*. The positive pole of the battery should be connected to the middle tap of the secondary winding, and the negative pole should be connected to the iron electrodes of the rectifier. The outside terminals of the secondary lead to the two aluminium plates, respectively.

It will be found that a rectifier constructed according to these directions will charge a six-volt storage battery at the rate of about two to two and a half amperes, while drawing about three quarters of an ampere from the line. When the rectifier is not being used, the plates should be lifted from the solution. The plates should also be cleaned frequently and the solution renewed every few months. The need of such renewal will be indicated by the heating of the solution. The aluminium plates waste away very slowly and do not have to be renewed often.

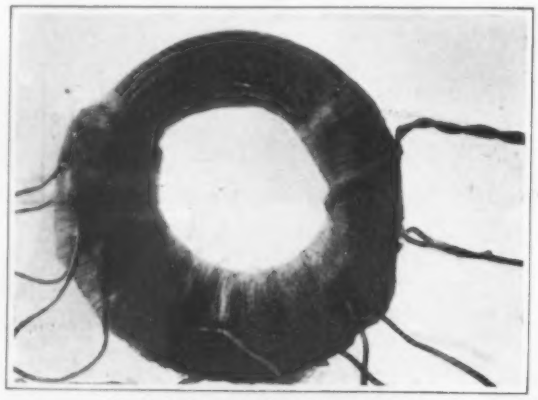


Fig. 1.—The completed transformer.

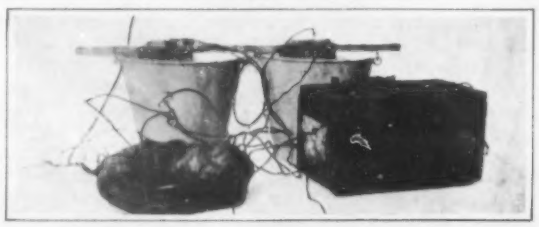


Fig. 2.—The rectifying outfit.

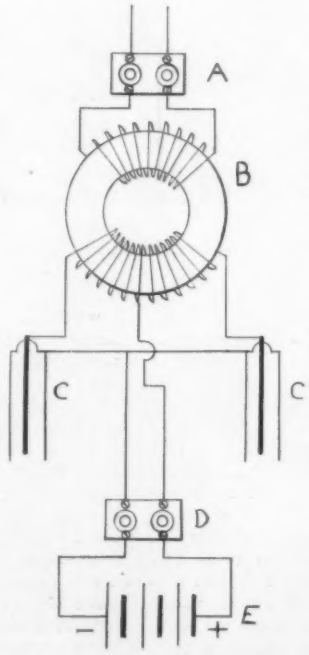


Fig. 3.—Electrical connections.

Protection Against Bank Note "Raising" and Forgeries

AN ingenious device for imparting security to bank notes and other security documents and means for detecting attempted forgeries, has been invented by Alfred E. Bawtree, an English electro-chemical engineer.

Mr. Bawtree has used as a basis for his invention the well-known principle of the sound waves of the phonograph record. For instance, he manufactures the paper upon which a bank note is to be printed with one or more edges of irregular, but predetermined form, such form corresponding to certain sound waves. For a five-pound note the edges record the spoken words "five pounds," and when placed in the reproducer the note plainly announces its rightful denomination. Mr. Bawtree claims this to be almost an absolute protection against "raising" bank notes or checks, since a note which is once a five-pound note is always a five-pound note, no matter how it may be changed on its face by the most skilful forgers.

The method of preparing the bank note is to cut a line through varnish spread upon glass, by a stylus which is connected to a diaphragm, the latter being caused to vibrate with the desired sounds. An enlarged photographic copy of this line is next made, and by hand or by a photo-mechanical process a zinc template is cut of the same enlarged form. This template guides a tool which cuts out the same form to the required scale in the form of a steel cutting knife. This knife is employed for giving the edge of the paper the required outline.

The device for use in reproducing the sounds thus recorded by the paper's edge, Mr. Bawtree describes as a pair of vertical cylinders rolling against each other and operated by a suitable driving power to rotate at the desired speed. A horizontal plane or table, having a hole in it under the line along which the cylinders touch each other, is fixed at a short distance below the lower ends of the cylinders. A reproducer or sound box, similar to some form of those in general use upon talking machines, is placed beneath the plane above described, and a suitably shaped stylus projects upward through the hole mentioned. The document to be tested should be held vertically with the edge under examination resting on the plane. It should be advanced until the rotating cylinders engage its vertical edge. They should then draw it between them, the roughened lower edge passing across the stylus which projects upward through the hole in the plane. This would cause the stylus to actuate its attached reproducing parts, when the nature of the sounds emitted would determine the genuineness of the document.

The wide possibilities of this device may be readily imagined. A bank employs a clerk whose sole duty might consist of running bank notes through the phonograph, and any of them which did not reply truthfully to their denominations would be reported as counterfeit. Or timid and suspicious private individuals could install in their homes or offices a machine which would advise them above a vestige of doubt whether their cash in hand was genuine or spurious.

In the illustration, Fig. 1 shows a general view of the device and Fig. 2 a section of the reproducing end with the horn and part of the strip *B* removed. Two strips of metal *A B* are separated by a thin and narrow strip *C* along one of the edges, thus forming a deep and narrow channel. A short fine slit *D* is cut in one strip *A* at right angles to the separating strip *C* and with one end just reaching it. A round hole *E* is cut in the other strip *B* exactly opposite the fine slit *D* in the first strip *A*. A flexible tube *F* is attached to this first strip *A* immediately behind the slit *D*, and a small reproducing horn *G* of ordinary construction is attached to the other strip *B* behind the hole *E*. Upon sending a blast of air through the slit *D* by means of the flexible tube *F*, from one's mouth, for example, and drawing the paper through the channel between the strips *A* and *B* so that its serrated edge passes across the slit *D*, the serrations induce the air to enter the horn in puffs of a frequency and intensity corresponding to the original sound waves, and so cause the desired sounds to be emitted.

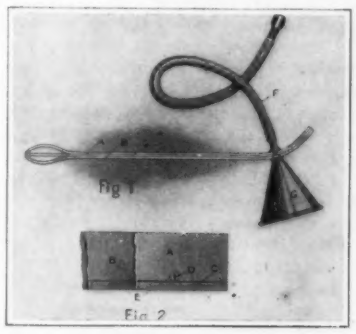


Fig. 1.—General view of bank note security device. Fig. 2.—A section of the reproducing end with horn and part of strip B removed.

A combination measure and funnel with automatic shut-off, designed primarily for the automobile owner or the garage man.

Forest officers have found that high power telescopes are not always satisfactory in fire-lookout work. In some localities heat vibrations in the atmosphere are so magnified by the glass that clearer vision can be had with the unaided eye.

Improving the Reproduction of Talking-machine Records

A SIMPLE clarifying, articulating and amplifying attachment for talking machines was discovered by the accidental touching of a fine needle with the finger while a record was being played. The inventor, M. B. Claussen, about two years ago, while testing out some records, happened to touch the needle and noticed that it vibrated. He was using a very fine straight-sided needle, which produced a low sweet tone, but lacked the power to propel the sound from the horn. This fine needle was free from scratch, and while it did not produce the volume of the heavy needle, it had none of the heavy needle's mechanical tones. Mr. Claussen argued that if he could add power to the vibration of this fine needle, it would reproduce all there was in the record with a volume equal to that of a heavy needle without any of the heavy needle's defects, such as scratch and aftertones. Besides, the great wear on the record caused by the heavy needle would be avoided. After trying many devices to increase these vibrations, he found that a disk of a certain diameter, thickness and density attached to the needle near its point, not only increased the volume of the fine needle considerably, but retained all the purity of the fine needle, and, at the same time, by its vibratory action eliminated the aftertones and caused each word and note to be reproduced clearly and distinctly. Some indistinct records even became audible. Tones never heard before were brought forth. The sound was lifted clear of the machine. The singer or musician was in the room, not in the box. It reproduced all the artist put into the record in the artist's natural voice, or with the musician's artistic touch. In its present form the device consists of a disk, two springs and an insulated metal band. The band is slipped over the circumference of the sound box, and the disk over the point of a fine needle. The springs hold the disk in place.

Tests, made under a microscope, of records played one thousand times with the device showed no perceptible wear. The long point of the fine needle had reached all parts of the record, but had not broken down the wall. Further experiments showed that by slightly increasing the length of a fine, straight sided needle, the vibrations were increased and the reproduction brought to a point of perfection. The device is made to fit this needle, and with it produces the best results.

A device which clarifies and amplifies the reproduction of talking machine records.

An Automatic Shut-off Measure

A COMBINATION measure and funnel, designed primarily for the automobile owner or the garage man, but useful also in many other ways, has been placed upon the market.

As shown in the accompanying illustration, the device is an ordinary metal measure with a funnel attached to the top. The most important feature, however, is the shut-off arrangement, consisting of a ball-valve and push-rod located in the lower end of the funnel. Oil or any other liquid can be very easily directed into a small-necked bottle or other vessel and, by means of the ball-valve, the flow can be stopped instantaneously by releasing the pressure on the thumb plate on the upper end of the valve rod. The valve is held tightly on its seat by means of a spring.

With this measure, a tank or other receptacle may be filled to any desired height and shut off without danger of overflowing. On placing the measure in an upright position after the filling, any liquid remaining in the funnel will run back into the measure without dripping on the outside.

Edison Uses His Old Telegraph Instrument Again

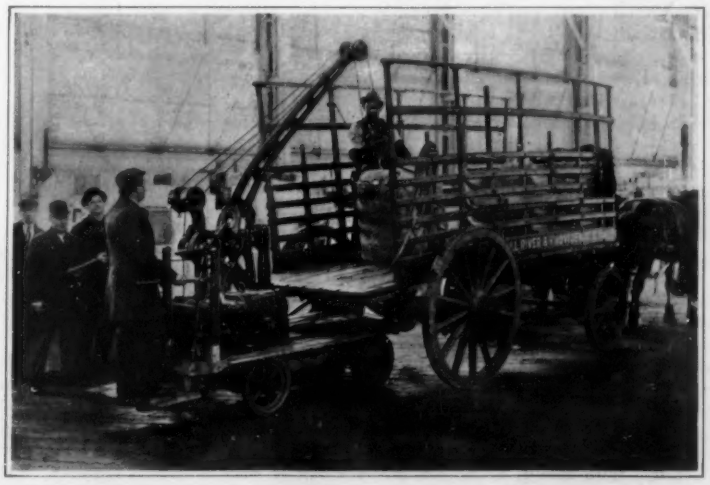
AT the meeting of the old-time Telegraphers' Historical Association of the United States at Mount Clemens, Michigan, on August 28th, Thomas A. Edison sent a message over the wire to President Wilson. The occasion was of special interest, because Mr. Edison stood upon the same site where he stood when he sent his first message as a telegraph operator, and used the same instrument he used fifty-one years ago when, as a boy of fourteen, he sent his first message over the lines of the Grand Trunk Railway.

Back in the pre-telegraphic days, when Edison was only a newspaper boy on the Grand Trunk Railway, he showed his youthful enterprise by printing and selling a small newspaper containing the news along his route. He kept a little font of type in the baggage-car and printed the paper on the train, so its items were strictly up to the minute. It was during this period that a trainman lifted him by the ears, later causing the deafness that now blurs his hearing.

A New Compensating Quadrant Crane

IN an accompanying illustration is shown a new hoisting crane, the invention of Capt. A. P. Lundin and Axel Welin, two marine engineers. Although this crane was first announced about a year ago, it was not until recently that it came into general industrial use, being manufactured in several different models. The type shown is a one-ton crane with a compensating quadrant fastened at the lower end of the jib, which can be raised or lowered. The quadrant is provided with teeth that engage in a rack and roll in a slot in the bottom plate. An actuating screw works in bearings in the top frame. This actuating screw swings the quadrant by means of a nut which slides on a guide at the top of the frame. The bottom plate is provided with four rollers for slewing and each model is so constructed that it will operate through a complete circle. In the self-loading model, the jib can, of course, be pointed in any direction by manipulating the truck on which it is mounted.

The compensating quadrant has two functions, the more important being to give the load a horizontal travel. With a multiple speed, obtained by means of an electric motor and gears, many sized loads can be adjusted without changing gears.



One-ton truck crane with compensating quadrant.

The Motor-driven Commercial Vehicle

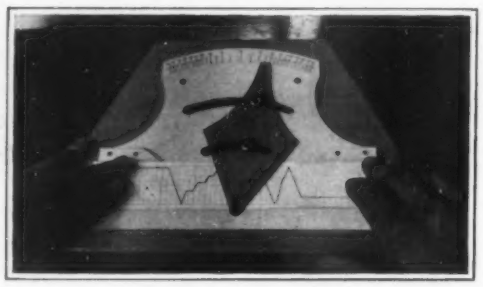
This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The Editor will endeavor to answer any questions relating to mechanical features, operation and management of commercial motor vehicles.

A Vehicle Movement Recording Device

ALTHOUGH transportation by motor vehicles has become largely a science, thanks to the efforts of efficiency engineers and others, and routes once covered in a haphazard manner at the discretion of the driver now are plotted and covered according to the well thought out plans of some one who has supervision and who can best visualize the system with a view to promoting its efficiency, the fact remains that drivers still are out of sight of, and consequently out of the influence of, their superiors or whoever may have the good of the service in charge, for a considerable part of their time. That most drivers maintain their schedules under such circumstances—when the watchful eye of the "boss" is absent—is a tribute to the honesty of the fraternity, though it by no means obscures the fact that other drivers, less honest, do not scruple to loaf when the occasion presents itself. It is to check the performance of these drivers and their vehicles that the instrument shown by the accompanying illustration has but recently been brought out. Needless to add, the instrument performs valuable service, too, when applied to the vehicles driven by men who are known to be perfectly honest with their employers and who adhere rigidly to their schedules.

Examining the "log" of the truck.

The recording drum.



Device for measuring angles on the tape.

Briefly, the instrument records the time a vehicle has been in motion, the number and duration of the stops made, the mileage traveled and the speed of the vehicle at any moment it is under way. Despite the multiplicity of its functions, however, it is not as complicated as the result achieved would seem to indicate.

The record, which is made upon a tape about twice the width of the ordinary "ticker" tape, is produced in part by clockwork, and in part by the movement of the vehicle to which it is attached. The tape is an essential part of the device, of course, and therefore should receive consideration first. Its length is sufficient to permit the recording of 36 hours' service. It is ruled lengthwise and also transversely. The width of the tape represents a distance traveled of two miles, the subdivisions representing one quarter mile each. The vertical lines on the tape are the time lines and they represent 15-minute intervals. The tape is wound up on the large drum at the rate of one complete revolution of the drum every six hours by clockwork. Pressing against the tape there is a tiny pencil or stylus which is moved across the width of the tape by a cam mechanism operated through the intermediary of a flexible shaft from one of the front wheels of the vehicle.

When the vehicle is stationary, the pencil does not move, but as the tape is wound up on the drum a straight line, corresponding in length to the duration of the stop in minutes, is traced. Immediately the vehicle is set in motion, however, the stylus commences its travel back and forth across the tape, and as the movement of the tape is constant, the line traced by the stylus is at an angle to the vertical time lines, and it is this angularity of the record lines which permits quick and accurate readings of speed to be made. It is possible, of course, to divide the mileage as indicated by the travel of the pencil across the tape into the time interval, and in this way to compute the speed, but where many computations are made and quick work is essential a device similar to that shown by one of the illustrations is used; it is a convenience that has been developed for the quick reading of many tapes such as would come from the instruments on a fleet of vehicles, though it is not absolutely necessary and may be dispensed with as explained above.

In use, the record tape is placed beneath the transparent portion of the device, as shown by the picture, and when any of the record lines is placed directly beneath the hair-line, the speed of the vehicle for that moment is indicated by the pointer on the scale. Practice is necessary for accuracy, though it may be appreciated that the device affords a quick and easy method of determining speeds.

One example of the use of the instrument in determining the speed of a vehicle some hours after the occurrence of an accident will serve to make plain its undoubted advantage. Witnesses of the accident in question—it is a matter of court record—declared that a heavy commercial vehicle which killed a young lad in rounding a corner, was traveling in excess of 20 miles an hour and one went so far as to state the speed was nearer to 30 miles an hour. Examination of the record tape, however, served to demonstrate beyond cavil that at no time during the previous 12 hours had the speed of the vehicle exceeded 12 miles an hour, and that at the time of the accident it was traveling at the rate of 4 miles an hour.

In another illustration there is shown the method of removing the record tapes from the instruments after each day's work is complete. As the operator works only at night and as the illumination of garages is not always as brilliant as could be desired, he carries a miner's lamp affixed to his cap and operated by a small storage battery hooked to the back of his belt. With this lamp he can direct a beam of light upon the tape and examine readily the "log" of the truck.

The Motor Truck and the Freight Terminal

By Robert L. Niles

WHEN it is reflected that no railroad, steamship line, canal, towboat service, trolley line, or steamboat, as to the freight carried, begins at the beginning or ends at the end, that is to say, that every pound thus transported has had to be collected, and will have to be ultimately distributed, by some other method, by horse haulage or manual labor, the volume of such collection and distribution and the importance of the problem become most impressive.

The most serious difficulty the railroads are called upon to solve is the question of terminal facilities. The freight car, which, once upon its journey, may readily cover some 250 miles per day, is, at present, by the congestion of terminals, reduced to an effective average of but slightly over 20 miles, as Mr. J. J. Hill has so convincingly demonstrated. At the average return, in freight charges, of ½ cent per ton per mile, the earnings per car are therefore reduced from a possible $31.25 per day to an actual $2.50 per day—a figure at which profitable operation becomes well nigh impossible. The anomaly is presented that the larger a city the less profitable its freight tonnage in proportion.

The manifest solution for such conditions is, if possible, an enlargement of terminal facilities. Curtailment of earning power to the railroad is not the only result of congested terminals, it involves heavy additional and unnecessary expense to each individual shipper, and to all stevedores and teamsters, and proves the greatest obstacle to the employment of motor trucks in the collection and distribution of railroad freight.

From the standpoint of the general public, its health and convenience, the elimination of horse-drawn vehicles is greatly to be desired, yet, when investigation shows that an average of three hours per working day is wasted in delays at terminals, the motor truck becomes unprofitable for railroad service. Their added carrying capacity and increased speed are discounted by such idle times. As the result of such detentions the cost to shippers runs as high as 50 cents to $1 a ton and over per mile, or to one hundred to two hundred times as much as the mileage charge of the railroad, so that, save for distant points, the haulage charge is greater than the railroad charge. To the railroad, short hauls in the congested district are a source of loss, not profit.

In the interests of both the railroads and the shippers it is evident that some plan should be sought by which these delays may be avoided or diminished. As expressed heretofore, the natural solution would be the expansion of present terminal facilities, to wit, by extended trackage and platform space, as well as the approaches thereto, yet extensions of present sites would involve staggering expense, and an increase therefore of capitalization difficult, if not impossible, to secure.

There remains, therefore, the alternative of the establishment at other and different localities, of supplemental receiving and delivery stations, where such needed trackage and space either at present exists or may be cheaply acquired.

Such a solution, however, would necessitate much longer individual haulage, which in the case of horse-drawn vehicles would seriously detract from the advantages of the prompt service thereby secured. It is here that the motor truck appears to its best advantage. With its increased speed and carrying capacity, and ability for continuous, tireless service, regardless of length of time in operation, a comparatively "long haul" becomes less burdensome than a comparatively short "wait." With horse equipment a "wait" of an hour is preferable to an additional length of haul of ¾ of a mile. With a motor truck an extra haul of four miles is less expensive than a "wait" of one hour. With motor equipment it becomes possible therefore to haul profitably to and fro from a distant point provided that by so doing prompt and effective accommodation may be secured. Some types of motor trucks have the added advantage that they can successfully haul trailers: to wit, inexpensive carrying bodies without expensive motor equipment. Such trailers to be left to be either loaded or unloaded, at leisure, and ultimately picked up and dispatched by the motor unit, itself either a load carrier or simply a motor, as conditions warrant.

It would appear therefore that through the establishment of such "annex" freight terminals, confined, it well might be, to certain classes of freight, or certain extensive shippers, the congestion of the terminals at present existing would be materially reduced, and it seems not too sanguine to imagine entirely removed, thereby expediting not only such tonnage as was therein handled, but that still distributed from original depots. Such service might well do for the various railroads what the New York Clearing House has done for its associated members, and expedite and lubricate the whole problem of freight handling. Manifestly it would not be necessary for such a system to attempt to handle even a substantial part of the whole tonnage.

Any fraction of the total thus removed from the congested zone would in ever-

Classified Advertisements

Advertising in this column is 75 cents a line. No less than four nor more than 12 lines accepted. Count seven words to the line. All orders must be accompanied by a remittance.

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A NEW ROTARY GRATER, Patent 1,051,499,—Embodying one of the most serviceable tools in the art.—One acquaintance named it "the housewife's relief." And one customer, a business man of this city, says in a letter among other pleasant words that he regards his purchase of a machine for $3.00 as the best investment he ever made. Good opportunities on proposals. F. T. Hoeynck, 1901 W. 13th St., Chicago, Ill.

EXCEPTIONAL opportunity. $10,000. A corporation giving up business will sell patent on article used by railroads; netted last year $2,500; business can be largely increased with little effort. For further details address: V. E., Box 773, N. Y. C.

PATENTS FOR SALE

PATENTS FOR SALE, cash or royalty, No. 913,764. Detachable Umbrella Handle, Chas. B. Post, Inventor, New London, Ohio; No. 830,553, Wire Stretching Device, Andrew Adams, Inventor, Kendallville, Ind.; No. 1,059,445 Automatic Music Leaf Turner, August Glauber, Inventor, 613 W. 25th St., Lorain, Ohio; No. 1,025,940, Game Board, Wm. J. Archer, Inventor, R. F. D. No. 1, Washingtonville, Ohio. Patent Specialty Co., 409 Prospect Avenue, N. W., Cleveland, Ohio.

SALESMEN WANTED

SALESMEN MAKING SMALL TOWNS—*Whole Time or Side-Line*, should carry our fast selling pocket side line. Special sales plan allowing return of unsold goods. Makes quick, easy sales. $4.00 commission on each order. *Something entirely new.* Write for outfit today. Canfield Mfg. Co., 208 Sigel Street, Chicago, Ill.

INQUIRY COLUMN

READ THIS COLUMN CAREFULLY. You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. There is no charge for this service. *In every case it is necessary to give the number of the inquiry.* Where manufacturers do not respond promptly the inquiry *may* be repeated.

MUNN & CO., INC.

Inquiry No. 9317. Wanted the names and addresses of manufacturers of good selling articles that would appeal to the public where exclusive sale in certain territories can be arranged for; both to sell to the trade and through sub-agents in a house-to-house canvass.

Inquiry No. 9318. Wanted rollers and other appliances for extracting water and moisture from refuse, such as coir dust, with special reference for using it as a fuel.

Inquiry No. 9319. Wanted the name and address of concerns manufacturing novelties in table or pocket cutlery for the wholesale or mail order trade.

Inquiry No. 9320. Wanted an article suitable for large manufacturing—plant equipped for making Boats, Marine Engines, etc. The plant would be capable of making almost any article. A large wood-working establishment is also operated in connection with the metal shops.

Inquiry No. 9321. Want name and address of a firm who could make a machine for turning out rat buttons. The machine must be capable of making the dough of the exact size required, and also a machine to manufacture the tins and a machine for placing the dough in the tins. Preferably this machine should do all of this work in one operation.

Inquiry No. 9324. Wanted—prices including discounts and full particulars of reliable and inexpensive voiturettes or motor cars for export.

Inquiry No. 9325. Wanted the name and address of some stamping concern in New England who could manufacture a window shade bracket, the materials to be used being 14, 16 and 18" gauge.

Inquiry No. 9326. Wanted to communicate with those having inventive ability with a view of acquiring or assisting in developing an invention for mail order use.

Inquiry No. 9327. Wanted to get in touch with a patentee of some article requiring a small amount of capital and selling ability.

Inquiry No. 9328. Wanted, names and addresses of manufacturers of curtain poles and curtain pole brackets or extenders; also manufacturers of window shades.

Inquiry No. 9329. Wanted, names and addresses of patentees of useful household utilities preferably for use in the home laundry or kitchen. This inquirer wishes to correspond with a view of purchasing patents outright.

increasing proportion reduce such congestion; for in the handling of freight as in handling passengers, a small percentage diverted, restores uninterrupted flow to the mass.

"Toppings" for Motor Fuel

TO test out a new kind of carbureter a motor truck recently made a trip from Los Angeles to San Francisco, using as fuel oil "toppings." The distance covered was 472 miles and about 46½ gallons of fuel were used, giving an average of over ten miles to the gallon. The car was of 1,500 pounds capacity, and was loaded with over 2,000 pounds. The entire bill for fuel amounted to $1.40, and in addition to this 3½ gallons of lubricating oil were used. The "toppings" are that portion of the refinings which float on the top of the tank and have heretofore been considered practically a waste product. The specific gravity is only 41 degrees at a temperature of 85 deg. Fahr., and the cost 3 cents per gallon. The following is a table of fuels, giving their specific gravities and the cost per gallon at Los Angeles:

Fuel.	Gravity, Baumé 60° F.	Cost per gal.
Oil toppings	38.5	.03
Kerosene	42.7	.09
Distillate, ½ kerosene	47.6	.08
Distillate	51.4	.07
Gasoline, ½ distillate	55.3	.11
Gasoline	59.7	.14½

Motor Truck Queries

M. O. L. writes: "In my grocery business I use eight ½-ton motor delivery wagons for regular deliveries, and a 2-ton truck for hauling my goods from the railroad to the store. Is there not some light vehicle which I can use for 'special deliveries' to give prompt service to customers after the regular delivery has been made?"

A. It is not to be expected that a delivery wagon used under these conditions would be run at nearly full load. In fact, nine times out of ten you would probably not have occasion to carry more than one hundred pounds—and much less than this in many instances. These are conditions under which a motor truck cannot be made to show a maximum return on its investment, but as a convenience to patrons and an advertisement, it would soon prove its value. What you need is a speedy, 500-pound vehicle that is easily handled and that can travel 35 or 40 miles on a gallon of gasoline. There will not then be such a discrepancy between its rated capacity and the normal loads it will be called upon to carry, and the cost per delivery will thus be kept down. It would seem that a three-wheeled "motorcycle truck" would well answer your requirements. Such a vehicle can be obtained at prices in the neighborhood of $400, and can carry loads of 600 pounds and over. The regular motorcycle with sidecar delivery van can be bought for about $330. This has a capacity of 400 pounds and, like the one mentioned above, is no more difficult or expensive to operate than is a motorcycle.

J. H. O. writes: "I have a large barn which I wish to convert into a garage for my delivery trucks, now stored in a public establishment. I have alternating electric current in this barn, and would like to know if there is any manner in which I can convert this into the direct current for charging electric vehicles.

A. You will need what is known as a "rectifier." These are made in several different sizes and styles, and it will be necessary for us to know the voltage and number of cycles of your alternating current, and the number of batteries you will need to charge, together with their charging rate. The smallest instrument suitable for charging a single electric commercial vehicle at 30 amperes costs in the neighborhood of $250. Of course this rectifier can be used for an indefinite length of time, and thus several vehicles may be charged in succession. To charge more than one set of cells at a time, however, you will need a larger outfit.

Va. writes: "We operate five 3-horse trucks in our coal business, but want to 'motorize' our delivery equipment as soon as possible. These heavy trucks represent a considerable investment, however, and as some are provided with modern elevating bodies, and others with the latest type of side chutes, we are anxious to know if these can be mounted on a motor truck frame—and thus save a portion of the cost of the installation."

A. Not only will you be able to use the original truck bodies, but the rear wheels can be put to good service as well. By the use of a motor tractor to furnish the power, you will not need to "scrap" any of your old truck equipment except the front wheels. When these are removed, the front of the truck is placed on the "fifth wheel" provided for the purpose on the rear of the platform of the tractor, and the old body and rear wheels thus serve as a trailer. By the use of such a tractor, the capacity of the original bodies is at least doubled, inasmuch as twice the number of trips can be made, or the same number of deliveries can be carried a greater distance. By means of the proper rigging, the bodies may be easily removed or set in place on the tractor, and thus one body may be loaded while the other is being run to its destination. The operation of a tractor and trailer is not difficult, even in congested traffic, although of course the vehicles could be run only a short distance on the reverse.

B. E. M. asks: "Why is the 'fixed spark' used to a greater extent on trucks than on pleasure cars? What are its advantages?"

A. We do not know for certain that the fixed spark *is* used to a greater extent on commercial trucks than on pleasure cars. There was a time when the fixed spark was popular with taxicab manufacturers, but while these machines are listed under the head of commercial vehicles, they could hardly be classed as *trucks.* The fixed spark has been applied to some pleasure cars in the effort to simplify the control of the vehicle, and it is this same desire on the part of manufacturers that, at certain times, has made it seem a popular design on trucks. The fixed spark renders a motor car more nearly "fool proof," but does not allow of that regulation of ignition that is necessary for efficient running at all speeds. On the assumption that the motor truck driver either is not as intelligent or will not exercise the same care as the owner of a pleasure car, some truck manufacturers have set the spark to occur at the top of the compression stroke and have then eliminated all means for changing it. This is the position which is not liable to produce a back-kick at the starting crank, and yet one which gives good results at ordinary speeds of the engine. At high engine speeds, it is advisable to set the spark to occur before the upper dead center of the compression stroke is reached. Improper regulation of the spark, however, may be more harmful than a constant position, and the personal equation is therefore the determining factor as to the advisability of the set or variable spark.

A. L. P. asks: "Why are not more self-starters to be found on motor trucks?"

A. The motor truck is a business necessity, not a luxury, and every cent spent on it must show its proper return. Furthermore, the number of pleasure cars in use at present far exceeds the trucks, and designers have therefore turned their attention to applying the starters to what would seem to be the more profitable field. The automatic starter is still a new-comer to the automobile field, and has not been in use on the majority of cars more than two years. The time is not far distant, however, when the trucks will be provided with this "luxury," and owners will find that it will pay for itself in a short time. The driver of a truck provided with an automatic starter will be more liable to stop his engine each time the vehicle is brought to a halt, and the gasoline saved in one year will be considerable.

EPICYCLIC TRAINS, which play an important part in toothed gearing, are ably described in Scientific American Supplement 1524. Price 10 cents. For sale by Munn & Co., Inc., and all newsdealers.

Notes and Queries.

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(12857) T. J. T. asks: I beg to inquire of you if there is such an instrument made to locate iron or steel two feet or more under the earth. A. Iron or steel may be located underground by the use of a dipping needle. This apparatus has a magnetic needle hung so that it swings in a vertical plane instead of swinging in a horizontal plane as the needle does in an ordinary compass. A dipping needle comes to rest with the north end below the horizontal in the northern hemisphere and the south end below the horizontal in the southern hemisphere. When over iron or steel, which is not magnetized, the lower end of the dipping needle will be drawn down toward the iron or steel, just as an ordinary magnetic needle is drawn toward iron or unmagnetized steel in a horizontal plane. By this attraction these metals may be detected when they are buried in the ground. A sensitive dip needle might indicate their presence at a distance even greater than two feet.

(12858) H. R. R. asks: There has of late years been a large amount of wheat raised in this part of the State and the last three or four years have been unusually dry. I have heard several persons say that if more corn and less wheat was raised there would be more rain: that the stubble fields cause the hot winds and drouth. A. As far as the Weather Bureau has been able to determine the matter, vegetation and forests do not influence the amount of rainfall. These things do prevent the ground from drying up so rapidly as it does when not covered with green and moist vegetation. 2. I read an article in a magazine stating that the stars made one complete revolution through the heavens every 22,000 years. Is this caused by the slowing up of the earth's rotation? A. The circuit of the heavens by the celestial pole is performed in about 25,800 years. This is not caused by the rotation of the earth upon its axis, but by the attraction of the sun upon the ring of matter about the earth's equator, 13 miles in excess of a sphere. This ring was caused by the rotation of the earth when it was hot and soft. The change is called the Precession of the Equinoxes. You will find it fully explained in Young's "Manual of Astronomy," which we will send for $2.50 postpaid. 3. What causes the sap to rise in trees? I always supposed it to be capillary attraction, but I have heard this disproved. Does growing vegetation bring rain or is there anything in this assertion? A. Capillary attraction assists the sap to rise in trees, but does not wholly account for it. Osmosis is the name of the force which accounts for most of this. Living protoplasm has the power of imbibing water very strongly and thus filling the cells of plants with liquid which is passed from cell to cell up the stem and throughout the tissues of vegetable structures.

(12859) H. A. asks: In my high school geometry class I was told that a prize had been offered for a geometrically proved method of trisecting any angle. I have heard that it was offered by some Russian college or institution. Can you tell me the name and address of such institution, and also the conditions of the reward? If you cannot, can you tell me where I can get the information? A. We do not know of any prize offered for the trisection of an angle by methods of plane geometry. This was long ago proved to be impossible. You will be interested in Klein's "Famous Problems of Elementary Geometry," price 55 cents postpaid, and Heath's "Mathematical Monologues," No. 3, price 15 cents postpaid. These will give you reliable information about this and other matters very cheaply. Angles are trisected by means of higher curves with great ease. For this see our SUPPLEMENT, Nos. 1895 and 1912, price ten cents each.

(12860) D. G. asks: I would like to know how to magnetize a magneto that has been demagnetized? I am in possession of a "Wagner rectifier," 6 volts, direct current, with an output of 10 ampere hours, with which I charge storage batteries. I am not clear as to whether I can magnetize a magneto with this same rectifier or not, and also how to proceed. A. You can remagnetize the magnet of your magneto with your Wagner rectifier. Wind two coils of wire of about 75 feet each, using No. 14 or 16 ounce cotton-covered copper magnet wire, one coil wound right and the other left handed, the two in opposite directions. Have the opening through the coils of such a size that the coils will slip over the poles of the magneto. Connect the coils in series so that the current will flow around the poles in opposite directions. Then one pole will be north and the other south. The coils should carry about 10 amperes, which will heat the wire considerably, but not enough to burn the insulation. No other harm will result, but you can cut off the current and allow the wire to cool and then turn the current on again, several times. This process will fully charge the magnet again. A small compass will be handy for testing the polarity, so that you need make no mistake by getting both poles of the same kind.

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